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Dental Cysts and Their Treatment—*Aison*
Child's Mouth—*Weeks*
Partial Denture Prosthesis—*Goslee*
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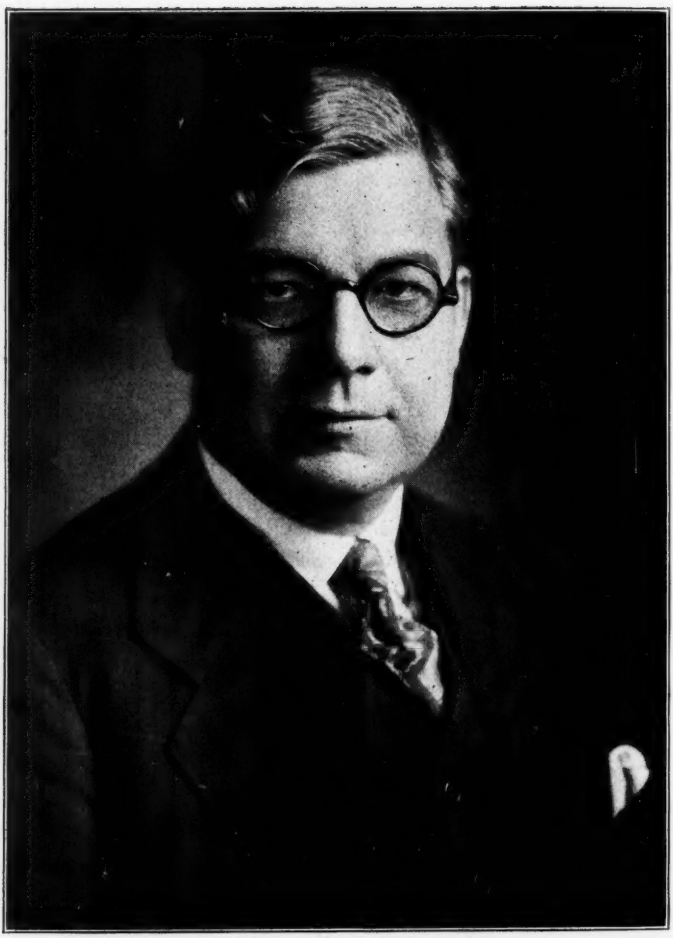

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Original Communications

THE RELATION OF MOTTLED ENAMEL TO CARIES*

By FREDERICK S. McKAY, D.D.S., New York City

I CAN find no better words for the opening statement of this paper than those used by Russell W. Bunting and his associates in their article, "Further Studies of the Relation of Bacillus Acidophilus to Dental Caries."[1]

In the study of dental caries, its etiology and the manner of its attack, two distinct schools of thought have arisen. Of these, one views the disease as a local manifestation of a constitutional disturbance; that is, susceptibility to dental caries is determined by the structure of the tooth itself, the quality of which may be so modified by metabolic and nutritional conditions that caries is induced or retarded thereby. The bacterial factors in the process of tooth destruction are considered to be secondary in importance to the resistance of the tooth as determined by its physical and chemical constitution. . . .

The second group considers dental caries as a purely infective process, the occurrence of which is determined by the bacterial factors involved rather than by the physical resistance of the tooth. They point to the fact that, under certain conditions, soft and poorly formed teeth are free from caries throughout the life of the individual, while in others the finest of tooth quality goes down under the attack of virulent caries. Thus they affirm that the occurrence of dental caries cannot be accounted for by the perfection of tooth formation or the inherent resistance of the tooth itself.

To adapt the foregoing quotation more closely to the need and purpose of this article, I would substitute the word "enamel" for "tooth" wherever it occurs in the quotation, and I would single out the word "resistance" wherever used in the quotation, for further consideration later in this paper.

The first of these two "schools" mentioned by Bunting is the older, the second finding its verification only after the researches of Pasteur, Koch, Miller, Black and Williams had become available.

In all the history of dentistry, there are no episodes more dramatic nor tempestuous than those occurring from 1886 down through the late nineties which

*Read before the Chicago Dental Society, April 17, 1928.

1. Bunting, R. W., and associates: Dent. Cosmos, 70:1 (Jan.) 1928.

raged around the efforts of the group led by Williams and Black to establish the fact that the determining factor in the production of caries was not the integrity of the enamel structure, but rather the character of the environment of the teeth.

This idea was warmly combated by another group, led by Abbott, Heitzmann and Bödecker, and these discussions as published in the *Dental Cosmos* of these years provide some interesting reading at the present day.

But in spite of the ramifications of these debates, sometimes far afield, what these men were really trying to determine was whether or not the enamel is a vital tissue, or, to put it another way, whether metabolic processes are possible within the structural elements of enamel.

Today, forty-two years after Williams' first publication, the composite mind of our profession is unable to decide definitely which premise it can accept, and there is, at the present time, no one question before us that it is more important for us to decide than this one: Is the enamel a vital tissue?

The encouraging feature is that at no time before have we been devoting so much thought and study toward its solution, in order that we may answer the question, "Why do teeth decay?"

If we can eventually determine that the great predisposing cause of caries is resident in the character of the environment, our chief duty becomes the clearing of this environment of its destructive feature.

On the other hand, until we shall determine that the enamel on human teeth is capable of undergoing metabolic processes, our efforts to build up a resistance that shall be inherent within its own structure, or to improve the quality of the enamel on erupted teeth, through changes in the diet, become the veriest empiricism.

The very foundation of our concept as to what we can do in order that decay be prevented is laid upon this question as to whether the enamel is capable of supporting metabolic changes after its development is completed and eruption has occurred.

At the time of Williams' early publications, the knowledge regarding enamel was extremely meager, and after his own intensive microscopic studies on it, he set forth his conclusions to the profession in 1886 in the following words:

> To what conclusions are we forced by the evidence? That enamel, once completely developed, undergoes no structural change during life, and probably no molecular change—at least, not in that portion which constitutes 97 per cent of its composition. There is the highest probability that all changes which occur in enamel are the result of the slightly increased or diminished amount of fluid which may penetrate from the dentine or the surface. The human body is not the scene of a hodge-podge of physiological activities. There is order and exactness everywhere. Bile is not secreted in the kidneys if the liver happens to be out of order; neither will the lungs elaborate chyle out of food material when the digestive tract refuses to perform its functions.
>
> There is intimate relationship and mutual helpfulness everywhere, but if evolution and development mean anything, they mean division of labor and specialization of function. Dentine is not formed from osteoblasts or cementoblasts, nor is cementum formed from the odontoblasts. Neither can the material from which the enamel is built up be elaborated in any other way than through the ameloblasts. How careful the surgeon is to preserve the periosteum if he desires a reproduction of bone! He knows, if its formative organ is destroyed beyond recovery, that there will be no further reproduction of bone at that point.
>
> Now, it must be remembered that enamel is the only tissue of the body the formative organ of which not only disappears but the enamel itself is removed from the position

of its development and completely isolated from all tissue concerned in its formation. This is a fact of great significance, and places enamel in a unique position, physiologically speaking, in which it cannot be compared to any other tissue in the body. The odontoblasts and their processes, the fibrillae, are the elements by means of which the dentine is formed, and they remain after development is completed to maintain the continued integrity of the dentine. And thus it is also with bone and cementum, the formative organs of which remain as the source from whence these tissues receive their nutritive supply.

Not so with enamel, however:

The ameloblasts are the enamel-formers. Its peculiar morphology and its molecular structure are impressed upon it by these histologic elements. They completely disappear, after which there can be no further formation of enamel. We have no evidence of structural change, by which I mean change in molecular relationship, which is the only change which could improve defective enamel. The apparent increased or diminished liability of the teeth to decay during life must be largely attributed to changes in environment, changes in the character of the secretions and fluids of the mouth, rather than to any inherent change in the enamel itself.

Concurring with Williams' statement in the main are the conclusions offered by Hopewell-Smith.[2] For the purpose of comparison, I quote as follows:

Evidences have been produced to show that the conception that enamel is capable of increase in size by natural and organic processes cannot be held, but that it is a formation or deposition of an inorganic nature, the active agents of which are the short-lived ameloblasts of the enamel organ. Through absence of these cells, it never repairs itself. It has no special affinity for certain chemical substances. It is entirely unaffected by the supply of oxygen in the mouth. By virtue of its non-vitality, it does not respond to physiological changes going on in internal or external conditions, and cannot shrink or contract in response to a stimulus. It undergoes no bio-osmosis but, like other inanimate objects, allows the passage through its substance of thermal energy and electrical ions. As it is incapable of selfprotection, so it offers no resistance to any form of stimulus. Adjustibility and adaptability to external conditions, so common in living matter, are completely foreign to its properties; while the early disappearance of the ameloblasts and enamel organs of the teeth does not admit of the reproduction of itself after injury or loss.

On account of the foregoing facts, it may safely be asserted that because of its formation as a secretion which subsequently calcifies and concurrently solidifies, of its lack of cells, fibers, blood vessels, nerves and lymph, of its unchanging adamantine character, enamel bears no analogy to or homology with any other structure of the body, and is therefore absolutely unique.

It follows that its reactions to injury and disease are similarly unique. Once its deposition is complete it cannot undergo atrophy or hypertrophy, or any kind of dystrophy; it cannot become affected by systemic nutritional disturbances, or degenerative, senile or any pathological changes. It can only exhibit in its structure the secondary effects (hypoplasia) of the malnutrition of, or the effects of disease upon its formative transitory cells.

At no period in our history has there been evident so much interest in this question as now, and that we perceive the fundamental importance of it in our search for the means of preventing caries is a most gratifying sign.

From the pages of the current periodical literature on dentistry, dietetics and hygiene may be gleaned almost numberless phrases and opinions which indicate that the deeply rooted idea, holding the integrity of the enamel structure to be the chief factor that determines whether or not decay shall occur, has a wide spread acceptance.

If then it is found that in a given individual caries is being inaugurated and is progressing rapidly, it is a logical deduction, in line with the foregoing hypothesis, that the enamel is therefore of poor quality, that is, poorly calcified,

2. Hopewell-Smith, Arthur: Dent. Cosmos, 69:468 (May) 1927.

and hence lacking in resistance to the carious process.

It is the persistent and widely held acceptance of this idea that is directly responsible for the statements frequently occurring in our literature urging that additions of calcium and vitamin-bearing foods be added to the diet for the purpose of improving the quality of the enamel and making it more resistant to the process of decay.

As illustrating the trend of this belief, I submit the following quotation:

> The last matter to be considered is the hope of improving the condition of the enamel of *erupted teeth* (italics mine) by diet or medication. This possibility depends primarily upon the presence of the organic matrix, which allows fluids to permeate the enamel. Will we not be doing mankind a great service, if we succeed in strengthening poorly calcified enamel?

An analysis of the ideas contained in this quotation brings out some points that we will do well to consider carefully. In the first place, what do we mean by "poorly calcified enamel" and how do we determine that a given enamel is poorly calcified? In making the pronouncement that a given enamel is "poorly calcified," is the operator guided by any other evidence than that gained through his clinical contact with the case?

Obviously, the determination of the degree of calcification cannot be arrived at short of the most exhaustive microscopic and chemical examinations. Has the operator been misled by the behavior of the enamel toward the force of cleavage exercised by the chisel or its degree of resistance to the bur? Is this not dependent more on the arrangement of the rods in their degree of parallelism than on the amount of lime actually therein contained?

I wish also to record the opinion that faulty or open fissures are in no sense an index to the degree of the general calcification of the enamel, but rather to be viewed as gross imperfections in the physical structure of the surface. The general calcification of the rods themselves may, in such a case, be as nearly perfect as in any enamel. So far as histologic evidence has shown, there are but two conditions, either one of which could definitely brand an enamel as being poorly calcified: either the rods themselves have been incompletely formed, or the interprismatic or cementing substance is deficient. Obviously, again, it would manifestly be impossible to detect either of these two faults from clinical evidence alone, unless the structural disorganization was so complete as to make its condition self-evident.

My plea then is for a greater discrimination in the use of this term "poorly calcified," bearing in mind what is actually implied when it is used.

To continue: Would a microscopic examination of enamels gathered from widely separated geographic areas, from persons in varying strata of society, and influenced by contrasting dietary habits, show any great degree of variation in their structural integrity or their degree of calcification?

Is it not true that enamel from all sources shows a remarkable uniformity in its structure and calcification? Has it been or can it be determined that an individual whose diet has been fundamentally defective during the developmental period will, because of that, present enamel that is definitely defective in its calcification? Do the multitudes of grossly undernourished children from the submerged social strata of the great cities exhibit enamel that is definitely inferior or poorly calcified, and if so, what phase of undercalcification does the enamel present?

On the other hand, is it true that, under exactly opposite conditions, the enamel will be found uniformly normal, as far as we understand what the enamel "norm" may be?

Is it not a fact that, under conditions varying from the most faulty to the most nearly perfect dietary supply during the developmental period, Nature, somehow, manages to appropriate from what is offered, sufficient material with which to build an enamel covering to the teeth that satisfies our understanding as to what is "normal"? Is it often apparent that Nature has definitely failed during the process of constructing this tissue?

Considering the almost universal dictum of histologists in declaring that enamel is by its very nature and genesis a "unique" structure, and hence not to be confused or compared with any other tissue of the human body, are we logical in seeking to make comparisons between it and the other tissues in their biologic possibilities?

The one peculiarity about enamel that confers on it its uniqueness is that it has no living cells. Though such cells have been searched for through and through under the highest powers of the microscope, no histologist has yet been able to demonstrate them. Frederick B. Noyes has declared it to be a "calcified fossil," in that the formative elements which functioned during the building process as vital secreting or appropriating cells themselves became calcified and are permanently fixed into the completed tissue, thereafter functionless.

There are other calcified tissues within the body, but to the last they retain and exercise their functional activity. Is it so difficult to find bone and cartilage cells, to say nothing of those of the various soft tissues, all of them maintaining a constant metabolism?

Without the presence of living nucleated cells within a tissue, a metabolic process is a biologic impossibility. How, then, can we expect calcific material that may have been conveyed through the lymph stream into the cell-less structure of the enamel, to be appropriated and built into the supposedly "poorly calcified" enamel, thereby improving its quality and rendering it more "resistant" to decay? The most that has been claimed is the presence of an organic or cornified matrix within the enamel in the nature of a rod sheath, and certain channels that have been interpreted to be for the purpose of a circulation. To endow such structures with an ameloblastic function is proceeding a long way in speculative metabolism.

I believe the term "caries," as applied to the enamel, to be a misnomer. It would be more accurate to refer to it as a decalcification, as the condition of the rods during the incipiency cannot be distinguished under the microscope from a decalcification.

In what way can this inert calcific mass exercise what is spoken of as "resistance" against the solvent action of lactic acid? Would the heaping up of more calcium derived from the improved diet, and delivered into the enamel by the lymph stream, in any way stay this chemical affinity of lactic acid for lime?

And how, in the total absence of any biologic machinery within the enamel capable of effecting such a change, is this organic compound of calcium, delivered by the lymph, to be translated into the inorganic form and built into enamel rods?

What material could be brought to the enamel through such a circulation that would modify the affinity of lactic acid for calcium?

Answers to such questions as these must be set forth, based upon evidence that admits of no confusion in its interpretation, before we can apply rational measures toward the prevention of caries.

Only such evidence will enable us to determine whether we are to direct our efforts toward alteration of the character of the environment of the teeth, or whether there is any justification whatever for our belief that we can, in some way, contribute something to the structure of the enamel on erupted teeth that will confer on it such a property as a "resistance" to decalcification.

The term "resistance" when applied to biologic functions implies an active process directed by cell intelligence acting against the harmful invasion, whatever its nature may be. As decalcification of the enamel is chemical and concerned only with the affinity of lactic acid for calcium, the enamel plays a rôle that is entirely passive.

The reason teeth decay is not because the enamel is not "good" but because of the chemical affinity of lactic acid for calcium. If the enamel could be improved in its structure, this natural chemical affinity would in nowise be altered or deceased.

Therefore I believe the use of this term "resistance" to be most erroneous and misleading, and hence entitled to no place in our conception of the onset of dental caries.

When the investigation of mottled enamel was begun more than twenty years ago, it was with no further thought than of determining the extent and mode of occurrence of this affliction, and it was not until within the past three or four years that the realization came that here was a subject which, when correctly interpreted, would tremendously illuminate the whole subject of enamel, particularly the relation that its structural integrity bears to the onset of decay, or, in other words, this old question that had filled the past decades with controversy.

As this lesion of the enamel has been described and illustrated many times in our literature during the past several years, only a brief description will be given here.

The original description, as given by G. V. Black and published in 1916, set forth that the fundamental defect was the absence of the cementing substance between the enamel rods; but later work by Williams has shown that the rods themselves, on their peripheral surfaces, have suffered damage during the formative period, or at least prior to eruption, that cannot be distinguished from decalcification. At any rate, they are profoundly altered in surface contour and diminished in transverse diameter. In appearance under the microscope, the damage cannot be differentiated from the decalcification of incipient "caries" (if I may use the term).

In pronounced cases of mottled enamel, the color is dead white, and the entire surface of the enamel of all the teeth is of this character. As a rule, the surface is perfectly smooth as in normal enamel, except that, in some cases, the points of the cusps are imperfectly formed, and in other cases, there are small pits scattered over the labial and lingual surfaces. In some extreme cases, the surfaces are very much roughened, as though corroded. Dr. Black characterized it as the "strangest thing in dental pathology."

It is necessary, at this point, to insist that there be no confusion between this lesion and that other commonly called "atrophy," for which Black suggested, as being more comprehensive, the term

"contemporaneous accretional deformity." The latter may be described as a gross deformity of the shape of the tooth, affecting the dentin as well as the enamel; while mottled enamel is a disturbance of the minute structure, affecting the general shape not at all, and only the enamel. It is further understood that, in communities in which this condition is endemic, practically 100 per cent of the native population is afflicted.

Here, then, is a condition in which the enamel is most obviously and unmistakably defective. In fact, it is the most poorly calcified enamel of which there is any record in dental literature. The lack of calcification is in this condition perfectly evident from the appearance alone, and it requires no laboratory demonstration to determine the fact.

If the chief determining factor governing the susceptibility to decay is the integrity or perfection of the calcification of the enamel, then, by all the laws of logic, this enamel is deprived of the one essential element for its protection. It erupts in this condition, and all through the childhood years, during which the susceptibility to decay stands at the highest point, there never has been an instant during which it has not been beset on all sides by those influences that make for destruction, and in this imperfect condition it remains for life.

In spite of this, the astounding fact is that mottled enamel shows no greater susceptibility to the onset of caries than does enamel that may be considered to have been normally or perfectly calcified.

This statement is made as a result of extensive observations and examinations of several thousand cases during the past years, in the course of which I have personally visited and examined every known afflicted district in this country, with not more than two or three exceptions, and about the same number of exceptions of localities that have just recently been reported.

My testimony has been supplemented by that of others, who report that these mottled enamel cases, in the various districts, are singularly free from caries. One of the first things noted by Dr. Black during his first contact with an endemic locality was the singular absence of decay, and it can hardly be said that his faculty for observation was superficial.

How shall we account for the apparent "resistance" of such tissue? Is resistance a faculty that can be measured in adverse ratio to structural integrity?

This destructive agency which operates during the enamel-growing period apparently ceases at or before eruption or, in other words, when the calcification process has been completed, because the condition of the enamel at eruption remains unchanged for life, at least as far as ordinary methods of observation are reliable. It is, therefore, unlike the acid decalcification of incipient caries, not a continuous process. Mottled enamel neither improves in quality nor does it undergo further deterioration.

This absence of any manifestation whatever of any evidence of a repair or recalcification process throughout life, but particularly during the childhood years, during which the processes of calcium metabolism are at their height, is most significant.

Under such a condition as this, there exists not only the utmost necessity, but also the most glorious opportunity for the exercise of the function of repair. Then why does this function so consistently and invariably fail?

Even in those cases which manifest just the slightest damage to the enamel,

and where any repair would be easily observed, the failure is the same.

The argument presented in support of the possibility of continued calcification is to the effect that complete calcification of the enamel to the point where diffusion of liquids becomes greatly reduced is the ultimate point in excellence of structure to which enamel can attain, and that such enamel thereby becomes "caries-immune." Until this complete solidification of the enamel has occurred, the calcification process is incomplete; hence, in proportion to the degree of porosity, the structure is susceptible to caries. In fact, the term "porosity" is, by this argument, made to represent the accessibility of the enamel to the fluids of the dentin, which are said to carry the calcifying elements.

No enamel has yet been demonstrated which has been left in so unfinished or undercalcified a condition, or which is so completely porous through so large a part of its structure, as is mottled enamel.

Its extreme porosity offers every opportunity for the freest circulation of this fluid from the dentin and, by every token, the most excellent opportunity for further calcification. What stops it?

The usual processes through which Nature repairs the other damaged structures of the body, even where the situation has been complicated by virulent infections, are promptly applied, proceed vigorously and rapidly, and the results are generally satisfactory. These facts hold good for the other calcified tissues such as bones, as well as for the soft tissues.

It would seem, therefore, that a period of several years, or even the lifetime of an individual, might be considered as offering a reasonable opportunity for a repair process to make itself evident. Must we wait a lifetime, then, before our efforts to improve "poorly calcified" enamel by an enriched diet, in order to increase its "resistance" to decay, are to become evident?

It cannot be argued with any degree of logic that the entire native populations of these various districts which are endemic to mottled enamel have uniformly been denied diets that were lacking in those elements that were necessary for the repair or improvement of their defective enamel, if such a thing were possible.

To assume that, once in a while, there might not be some person in one of these districts who would acquire enough of these foods that are rich in the necessary ingredients to bring about the repair is to strain our credulity.

Another most important point brought out by this study of mottled enamel, and one that has a most significant bearing on the case, is that it is possible to bring about structural alteration within the enamel elements only during the formative period.

Mottling of the enamel is produced by some substance at present not determined, but, from overwhelming evidence, believed to be contained in the water used during the enamel-growing years. This substance acts invariably on all forming enamel, and the damage it produces is identical as between individuals and between geographic districts wherever situated.

This is a perfect example of the working of a natural law; under the same conditions, the same result always follows.

We are taught further that a definite destructive or inhibiting process is necessary before enamel can be demonstrably interfered with in its calcification, as in mottled enamel. General errors in diet apparently do not produce this definite form of interference.

This water borne influence is the one example in dental pathology of a characteristic damage to the enamel through a dietary error, for such it must be considered.

I have been forced, through such evidence as we have been here considering, to the conclusion that any such thing as a circulation through the enamel capable of exercising a metabolic influence toward a further calcification of formed enamel is without foundation in fact, and that attempts to exercise such a beneficial influence through alteration in the diet is a forlorn hope.

2 East Fifty-Fourth Street.

DENTAL CYSTS AND THEIR SURGICAL TREATMENT*

By EMIL L. AISON, D.D.S., Chicago, Ill.

THAT the question of the origin of cysts found in the jaws has been the cause of much discussion and considerable controversy becomes at once apparent when a study is made of the vast amount of literature available on this subject from the pen of many eminent investigators and clinicians.

Excepting recent improvements and refinements in surgical technic and methods of treatment, there is nothing new in the understanding of this disease, especially with regard to its genesis, etiology or pathology. The present-time collective view of most observers is that the entire group of cystic and solid epithelial growths developing in the jaws arise from the paradental epithelium or epithelial cell-rests, to which attention was first directed by Malassez.[1] These researches have been augmented by those of other investigators[2] and much elaborated on by many writers. A review of this work, now well known, would seem elementary and unwarranted. From the clinical standpoint, cysts of the jaws present problems and aspects which might be stressed, with certain features brought out more clearly, even at the risk of repeating facts known to many.

Cysts arising about the teeth and jaws are, in the order of frequency of their occurrence: (1) the dental or root cysts, (2) the dentigerous or follicular cysts and (3) the multilocular cysts, or adamantinomas. Dental root cysts, radicular or periosteal cysts as they are sometimes called, are the most common of the several types of cysts found in the jaws. Because they are so often associated with abscessed roots and teeth, failure to recognize the true pathologic process involved is a common occurrence. Physical signs and symptoms as well as roentgenographic shadows are not infrequently

*Read before the Section on Oral Surgery, Exodontia and Anesthesia, at the Sixty-Ninth Annual Session of the American Dental Association, Detroit, Mich., October 26, 1927.

1. Malassez, L. C.: Rôle of the Paradental Epithelial Débris, Arch. de physiol. norm. et path., vol. 5, 1885.

2. Von Brunn, A.: Rôle of the Enamel Organ in Tooth Formation, Arch. f. Mikroskop. Anat. u. Entwicklungsgesch., vol. 29, 1887. Von Hertwig, Oskar: Principles of Evolution in Man and the Vertebrate Animals, Jena: Fisher, 1906, 1915. Gallipe, V.: Paradental Epithelial Débris (after the work of Malassez), Paris: Masson and Co., 1910. Liebault and Canuyt: Infected Bony Cysts of the Paradental Membrane, J. de med. Bordeaux, vol. 44, 1914.

erroneously interpreted as manifestations peculiar to other diseases about the oral tissues and closely associated parts. As a result, faulty diagnoses are made which vary from dento-alveolar abscess, granuloma and necrosis to osteomyelitis, maxillary sinus empyema and even carcinoma. The treatment which usually follows, treatment of hopelessly diseased teeth, unwarranted invasion of the maxillary sinuses, unnecessary radical operations or mutilating excisions when the size of the lesion seems to suggest such a procedure, is very destructive.

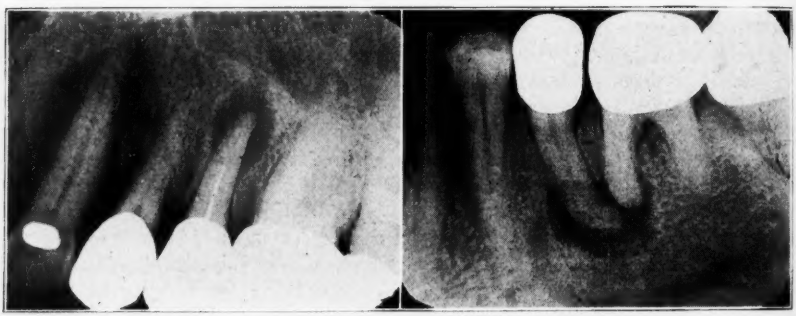

Fig. 1.—Ordinary type granulomas, which frequently precede root cyst formation.

The factors most potent in the development of root cysts are chronic infections about root apices. The disease is, in most instances, preceded by the formation of granulation tissue or a root granuloma. (Fig. 1.) Not all granulomas develop into cysts. Abnormal outgrowths composed of cellular connective tissue containing strands and groups of epithelial cells that are present around root apices, the periodontal membrane and dental pulps may become activated by bacterial or traumatic irritation and inflammatory processes. Proliferation of new cells and dilation of the lumina that they surround will take place. Breaking down of these cells and formation of fluid are gradual. Pressure atrophy of surrounding bone is slow but progressive. A circumscribed cavity, shut off from the surrounding bone by a fibrous connective membrane or sac lined with epithelium composing the cyst, is formed. (Fig. 2.) These cysts are filled with fluid, often containing cholesterin crystals, and varying in color, according to condition and duration, from a thin white or grayish white to a thick crystalline or dark, golden brown. They may vary in size from a small papule to that of an egg or larger. (Figs. 2, 3 and 4.) Any part of the human jaws may be the seat of such a lesion. They are found in jaws formerly affected by abscesses, even if the offending teeth were extracted, but the infection had not cleared up because of failure to remove the diseased periapical tissue and to provide for proper drainage and consequent healthy granulation. (Fig. 5.) An example of this pathologic process is found in the cysts of jaws which have been edentulous for many years. Old residual foci of inflammation left at the time of extraction are no doubt responsible for their development. (Figs. 6-7.) Fre-

quently, the anterior portion of the maxilla is found to be affected and the cyst wall extends to and even involves the floor of the nose. (Figs. 8, 9 and 10.) Large cysts under the antrums forcing the floor upward and causing either gradual obliteration of the sinus or actually invading this structure are not uncommon. (Figs. 11, 12 and 13.) There may be extensive loss of bone as a result of absorption, and there may be considerable distention of the cortical plates, this depending on the extent of the lesion and the thickness and resistance of these

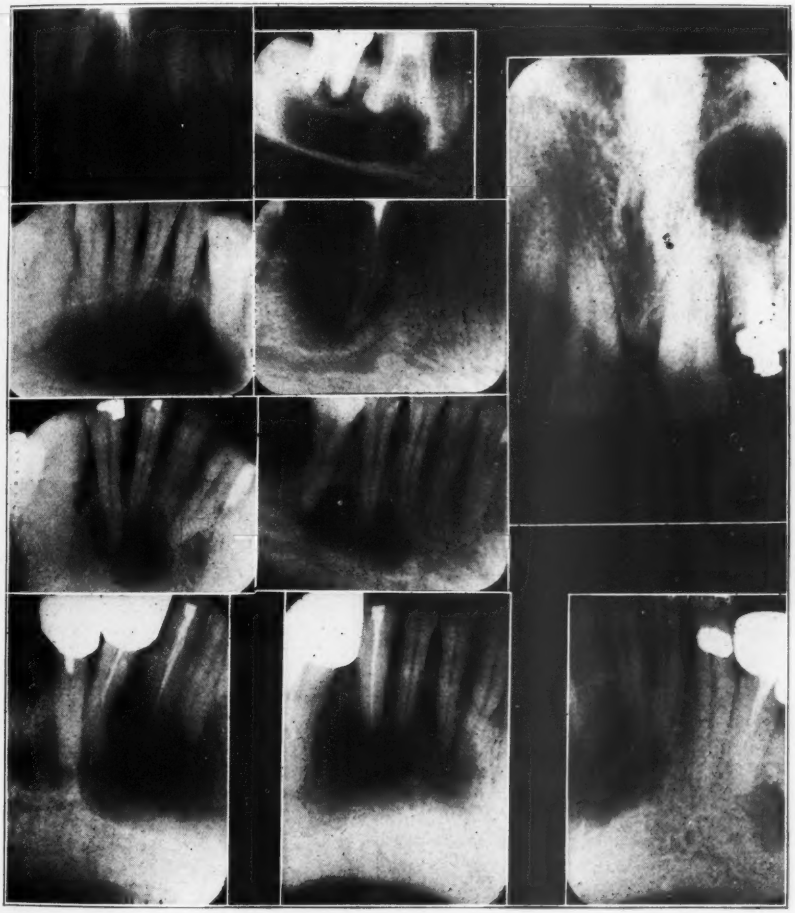

Fig. 2.—Group of cysts development of which is commonly activated by chronic peridental infection and traumatic conditions.

structures. (Figs. 3-4.) Occasionally, the teeth at the site of a cyst will be found to be vital and in good condition. A history of injury, such as a blow, or irritation produced by traumatic occlusion, will be found on close examination and inquiry, in most of such cases. (Fig. 14.) Root cysts are usually single, i.e., one or several teeth involved are surrounded by one capsule or sac. Multiple cysts are not rare, and several capsules connected with as many or more teeth may be found in close proximity to one another, and these are only separated by very thin septums. (Figs. 15-16.)

One of the features of this lesion is the complete absence of pain in many cases, especially when there are no acute inflammatory reactions; notwithstanding the fact that the lesion frequently exists for many years, as shown by the amount of bone destruction. Sometimes, a patient is completely unaware of the presence of trouble until, as a result of sudden pressure on a nerve, he is seized with violent pain. Frequently, there is a history of recurrent swelling and exudation of pus. Ocular examination shows distended, thinned out and parchment-like bone walls which yield readily to digital manipulation. The roentgenograms reveal evidence of destruction by a dark well-defined and sharply outlined cavity in the bone the margins of which are clearly outstanding. In the employment of the roentgen-ray as a diagnostic aid, care must be taken to guard against error in case of root cyst involving the posterior portions of the upper jaw since a correct diagnosis may become more difficult here, especially when the cyst is in the superior bicuspid and molar regions, where the maxillary sinus often obscures a clear-cut roentgenographic interpretation. (Figs. 13 and 17.) In this connection, mention may be made of the fact that there are instances in which there are cysts in the maxillary antrums without evidence or past history of dental infection. These result from the closing of the natural opening in the antronasal wall and subsequent retention of mucus and attendant pathologic changes. This condition is known also as hydrops antri or dropsy of the maxillary sinus. Treatment of this condition is within the province of the rhinologist.

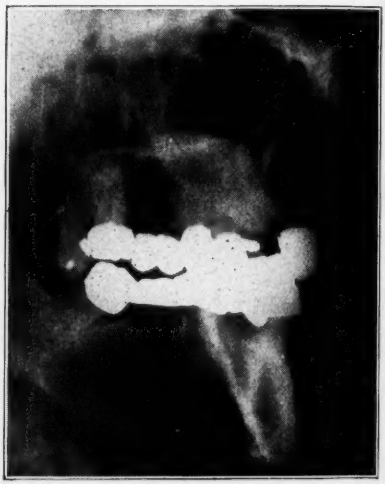

Fig. 3.—Large cyst of mandible with extensive loss of bone structure as a result of atrophy, brought about by pressure from the cystic contents.

TREATMENT

The treatment is surgical. The selection of a method which would prove most practical and best suited to the case at hand is a matter of much importance. This, because it is a question not only of eradicating a pathologic condition but also of conserving both teeth which may be vital and useful and tissues which are needed to support artificial dental restorations that may, on account of the size

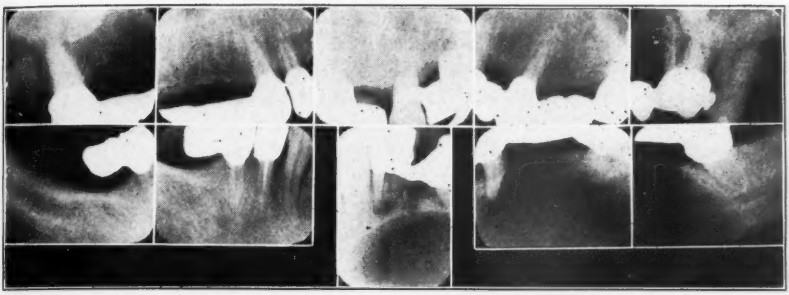

Fig. 4.—Case shown in Figure 3. The pathologic process involves the area between the mesial of cuspid on the left to mesial of third molar on the right side of the lower jaw.

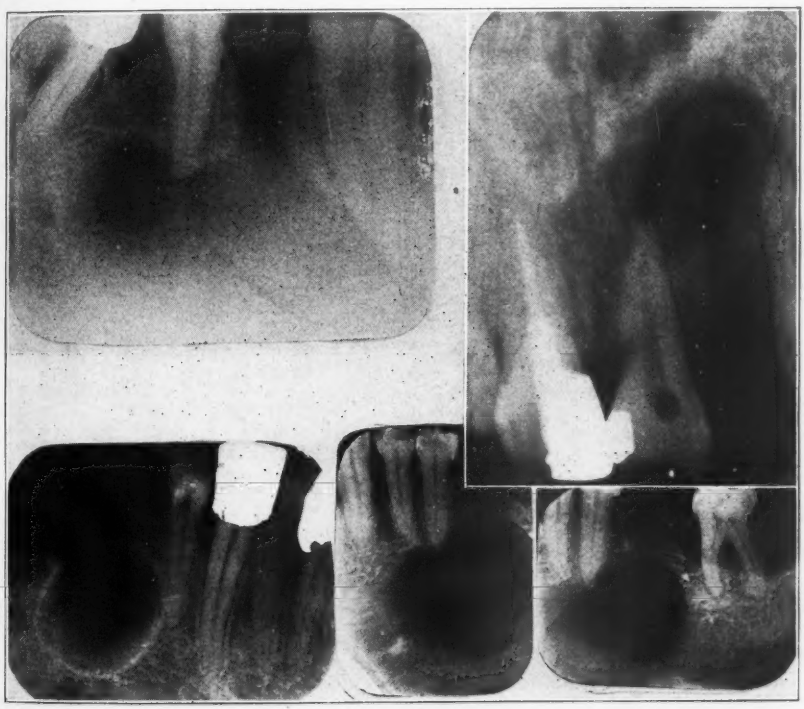

Fig. 5.—Cysts found in jaws formerly affected by abscess. The teeth involved were extracted, but no provision was made at the time for proper drainage and consequent healthy granulation.

and extent of the lesion, be sacrificed through radical surgery. From studies and observations[3] followed up over a period of years, it is my conviction that all cysts associated with diseased teeth are best treated by extraction of the teeth or roots involved and complete enucleation of the cyst sacs *in toto*. Attempts in a more conservative direction, namely, filling of roots and amputation of the apices followed by cyst enucleation, proved to be failures. There is not sufficient vitality about the periodontal tissues of such teeth to insure their retention. By a careful and conservative operative technic, sacrifice of a large amount of bone structure may be avoided. Destruction of the bone walls that is so complete as to extend to the end of the alveolar border just above the necks of the teeth is the exception, not the rule, especially in cases in which the cysts are not of great size. The conservation of this tissue that is later to become the ridge upon which dental appliances are to rest is not only possible but also necessary for symmetry and support.

A procedure which I have found simple yet effective is as follows: The area is disinfected. Anesthesia is obtained by the infiltration or block method. Either the overlying soft tissues near the region of the roots are incised in a half-curve, or one vertical incision is made, extending from the cervical region of the teeth upward if it is an upper, or downward in the lower jaw. The flap of mucoperiosteum is carefully detached at the gingival line and, upward from the bone wall, is retracted and held, care being taken to avoid laceration or injury to these tissues as they will be needed for a good closure of the wound. The overlying thin celluloid-like bone of the la-

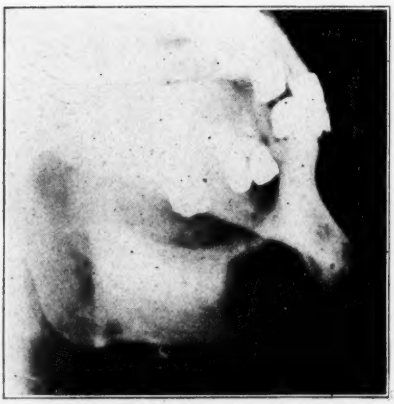

Fig. 6.—Cysts in the right and left sides of lower jaw which was edentulous for many years. This is a condition which frequently develops as a result of residual foci at the time of tooth extraction.

Fig. 7.—Cysts in the right and left sides of lower jaw which was edentulous for many years. This is a condition which frequently develops as a result of residual foci at the time of tooth extraction.

3. Aison, E. L.: Surgical Treatment of Dental Cysts, Bull. Chicago Dent. Soc., 4, No. 50, 1924.

bial or buccal wall found over the cyst is exposed and peeled away. When the destructive process has not reached that state, an opening may be made with chisel and mallet, but over the cyst only. The necessary amount of bone is then removed and the cyst sac exposed. When the roots of the teeth to be extracted have undergone hypercementosis or are curved, and difficulty in their removal or fracture of the lower alveolar border is anticipated, the roots may be cut off as the condition may indicate. The conservation of the bone ring at the periphery forming the teeth sockets assures the integrity of a vital part of the field operated in from the standpoint of future prosthesis, as new bone will fill these openings, thereby obviating the possibility of collapse and deformity. (Figs. 11, 18, 19, 20, 21 and 22.)

Should removal of protruding or irregular bone or edges become necessary for esthetic or other reasons it should

Fig. 8.—Cysts involving anterior portion of upper jaw and floor of nose. The teeth are vital.

Fig. 9.—Cysts involving anterior portion of upper jaw, floor of nose and maxillary sinus.

with bur or chisel. The teeth are then extracted. A periosteal elevator of suitable size is introduced around the cavity with which the cyst is detached from the bone, and the membrane is then grasped firmly with artery forceps and completely peeled out. (Fig. 18.) The bone edges are rounded off and made smooth and the cavity is washed out with physiologic sodium chlorid solution. The bone cavity may be scarified by gentle curettage to open the canaliculi and promote granulation. The overlying soft tissues are carefully coaptated and sutured. A drain may be inserted if necessary through the sockets of the extracted teeth, and changed for several days, and the wound may be irrigated

be done later, after filling in of new bone and calcification have taken place. Cysts of edentulous jaws are treated in the same manner, every effort being made to preserve as much of the bone ridge as the size and extent of the lesion will permit. The following advantages are to be gained from this procedure: 1. There is complete enucleation of the cyst capsule,

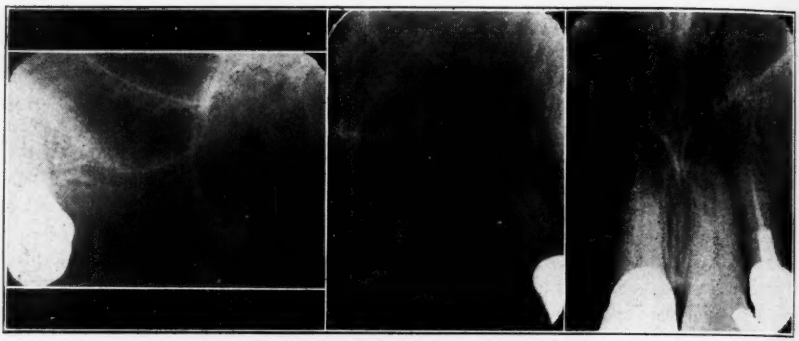

Fig. 10.—Cyst involving anterior portion of upper jaw, floor of nose and maxillary sinus.

Fig. 11.—Cyst involving floor and structure of antrum. The floor is forced upward and the sinus is partly obliterated.

insuring against recurrence. 2. There is usually healing by first intention, doing away with open wounds in the mouth, which heal slowly and are extremely disagreeable to the patient. 3. There is freedom from deformity.

Very large cysts, or cysts about a number of vital teeth, may be treated by the method of Partsch. This operation consists of incision and elevation of the mucoperiosteum over the cyst, removal of the overlying bone, which is usually thin and decalcified, exposure and incision of the anterior cyst wall, evacuation of the cystic contents and suturing of the cyst wall to the mucous membrane, followed by light packing and irrigation. The cystic structure becomes united with the oral tissues and undergoes changes, and the cavity slowly fills in with new bone,

but not completely. As has been pointed out already, this operation is of great benefit in large cysts and cysts about a great number of vital teeth where complete enucleation by the method previously described would entail permanent loss of bone substance and certain devitalization of the teeth and their ultimate loss as a result of interference with circulation and innervation. The disadvantages are slow healing over a period of months, the presence of disagreeable open wounds and failure to preserve entirely the symmetry of the jaw bone.

Dentigerous cysts occur much less frequently. Their origin is associated with misplacement during embryonal life; and aberrant development of the enamel germ remains and, as the term implies, is most always connected with teeth which are, however, misplaced, unerupted and sometimes imperfectly formed. The symptoms are similar to those in the case of root cyst. The bone walls become thin as a result of the pressure brought about by the fluid within the cyst, and a bulging develops on the affected side of the face and sometimes assumes large proportions. On pressure, the bony walls offer no resistance and there may be the characteristic parchment-like crackling. There may be normally erupted but infected teeth in the region. (Fig. 23.) Their presence is merely coincidental and in no way a factor in the development of this type of cyst. The mouth may also be entirely free from carious or infected roots or teeth. Ordinarily, a tooth or teeth will be missing in the region. The roetgenograms dis-

Fig. 13.—Region shown in Figure 17, taken higher up and showing cyst involving the antrum.

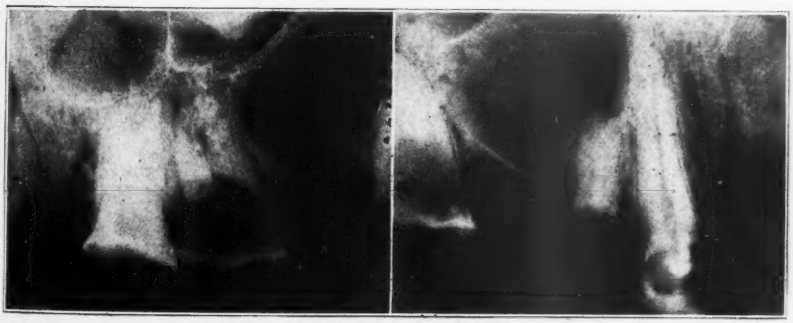

Fig. 12.—Extensive cystic involvement in bicuspid and molar regions of upper jaw with partial obliteration of floor of antrum. The second bicuspid and first molar which, according to history, were abscessed for a long time, were extracted five years previously. The case illustrates inadequacy of tooth extraction without further surgical treatment in this type of condition.

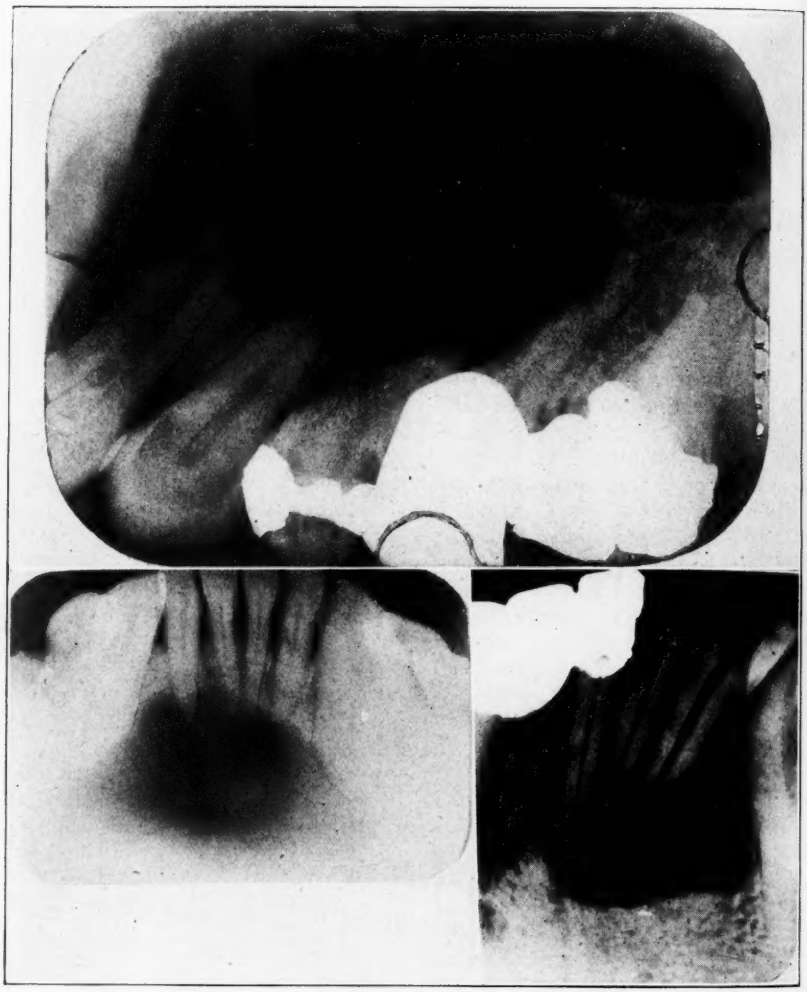

Fig. 14—Vital teeth at the site of cysts. The etiologic factor in these cases may be injury, such as a blow or traumatic occlusion. The peculiar feature here is that instead of the usual reactions incident to injury, such as abscess, osteomylitis and necrosis, the trauma causes an activation and proliferation of epithelial cells and cyst formation.

close the presence of a cyst and tooth or teeth within the cyst. Often, only the coronal portion is encapsulated, the roots being imbedded in the surrounding bone. (Fig. 24.) The cyst consists of a fibrous capsule lined with epithelium and filled with fluid, which varies in consistency and color as in a root cyst. It occurs about the period of eruption and in early adult life. (Fig. 25.) Supernumerary teeth give rise sometimes to these cysts, and, in that case, the normal complement of teeth are present. Since their development is the result of the misplacement of tooth germs, they are present in the alveolar process and also have been reported to be found in the palatal bone, the maxillary sinus, the ascending rami of the mandible and even in the orbit (Moorehead). Pain may be completely absent unless there is encroachment and pressure upon a nerve. Suppuration may take place through secondary infection and may result in severe inflammation and swelling of the neighboring tissues. On account of their tendency to recur, complete removal is indicated. This consists in opening into the bone, enucleation of the cyst and removal of the tooth or teeth, followed by careful coaptation of the overlying mucoperiosteum, and suturing. A drain may be inserted between the interrupted sutures and, after several days, discontinued and healing permitted.

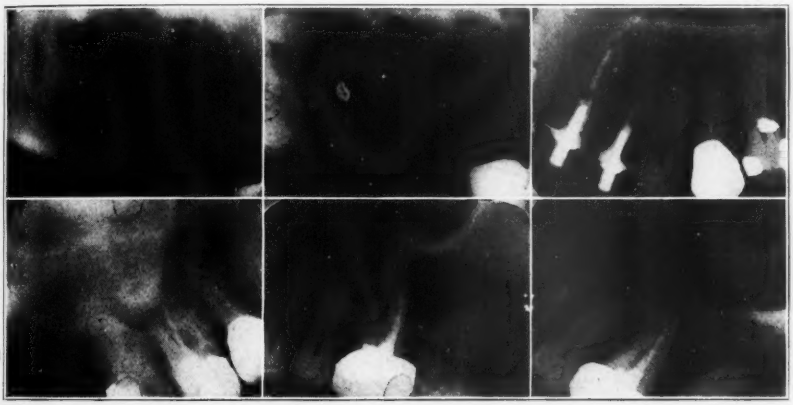

Fig. 15.—Multiple cysts of different size separated by thin bony septums.

MULTILOCULAR CYST OR ADAMANTINOMA

Benign growths of this type arise as a result of embryonic inclusion of the paradental epithelial débris of Malassez. They occur rather rarely and may be solid or cystic. Their development may be sometimes activated by the presence of diseased roots or teeth, or they may be sequences of root or dentigerous cysts. They are characterized by the formation of numerous cavities separated by thin bony or fibrous tissue septums which are filled with a thick brown fluid. Sometimes, this tumor is nearly all solid. The symptoms are similar to those in other types of jaw cysts. The cortical bone is found distended and en-

larged. There is swelling, which increases progressively. The patient complains of no pain. On pressure, the parchment-like crackling may be obtained, and if there is an opening, a discharge of brown, thick fluid may be elicited. The roentgenographic findings are typical. The treatment consists in complete enucleation of the cyst-structure including the cystic walls, followed by light packing and irrigation until healthy granulation is established.

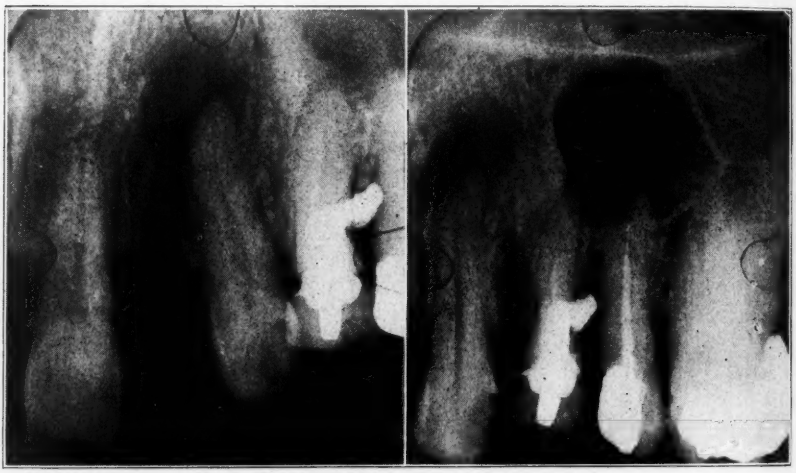

Fig. 16.—Multiple cysts of different size separated by thin bony septums.

PROGNOSIS

Although this group of tumors is regarded as benign, they may degenerate, following which a malignant growth may be developed. (Brophy.) On account of their tendency to recur and proliferate, especially when not completely removed, they are close to the border of malignant growths. (Brown.) Thorough eradication is therefore the rational procedure.

The illustrations here presented show some of the typical findings in these cases.

55 East Washington Street.

DISCUSSION

Theodor Blum, New York City: The subject "Dental Cysts and Their Surgical Treatment" is so large that it is impossible to treat it thoroughly in a short paper. In my discussion, I shall attempt to confine myself to the more important points only. The chapter on treatment is not quite clear and my own views are, therefore, summed up briefly as follows: Generally speaking, small cysts require radical, large cysts conservative, treatment. Root canal therapy and root amputation are indicated in both types, provided there is enough root and alveolar process after the operation to leave the tooth a useful member of the masticating apparatus. In my experience, the removal of protruding or irregular bone or edges never had to be done later. A monolocular cyst (radicular and follicular) never recurs, but its existence may continue if not properly treated. Dr. Aison enumerates the following disadvantages of the conservative (Partsch) operation: slow healing over a period of months, the presence of disagreeable open wounds

and the failure to preserve entirely the symmetry of the jaw bone. These would be disadvantages if compared with the type of radical operation during which the wound is completely closed. This operation cannot be performed in very large cysts, and, therefore, the conservative one must be compared with the type of radical operation at the end of which the wound cannot be closed or can be closed only partly, when the marked superiority of the conservative procedure must be admitted. Furthermore, there is no slow healing over a period of months and

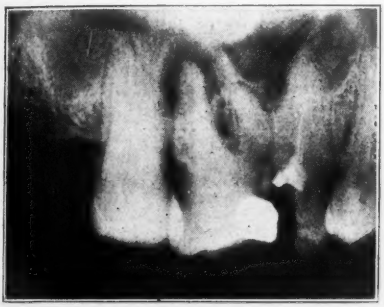

Fig. 17.—Upper bicuspid and molar regions, suggesting abscess formation.

disagreeable open wounds, but the opposite: after iodoform gauze has been changed for about ten days, the wound is only irrigated with a small so-called ear and ulcer syringe (made entirely of rubber), when the wound cannot be called open any longer. The patient makes few visits thereafter. The preservation of the symmetry of the jaw bone is not important. If the cyst was very extensive, there was surely enough asymmetry present so that the patient will not complain about the postoperative asymmetry, which, of course, will be restored by an artificial appliance. The presence of a normal complement of teeth diagnoses a tooth in a cyst as supernumerary, but the absence of such a complement does not exclude this decision. In fact, the decision is arrived at usually when examining the formation and appearance of the tooth. A discussion of the multilocular cyst or adamantinoma would be too lengthy and out of place. I would only call attention to the fact that conservative surgical treatment in conjunction with radium and the roentgen-ray has been fairly successful in a few cases and should be given a trial. The important monograph of Erich Becker must be mentioned to clear up most of the points on the origin of radicular cysts described by Dr. Aison. Becker maintains that the immediate cause of radicular cyst formation is hemorrhage into the peridental membrane brought about by bacterial, traumatic or chemical action. The *sine qua non* for the formation of a radicular cyst is a devitalized pulp and the presence of epithelial rests (Malassez) in the peridental membrane. Not every granuloma contains these rests,

Fig. 18.—Enucleated cyst in case shown in Figure 11.

and, therefore, not every granuloma changes into a cyst. A radicular cyst can develop without a granuloma from the peridental membrane provided the membrane contains epithelial rests. The blood accumulated in the peridental membrane at the point of hemorrhage coagulates, and if the coagulum surrounds the blood serum instead of the opposite (this whole process is analogous to cyst formations in the brain, bone and other parts of the body), the serum is not absorbed by the surrounding tissues, but forms the nucleus of the cyst fluid, which is increased through the products of degeneration of the connective tissue and blood vessels enclosed in and strangulated by the proliferating epithelial cells. The epithelial rests of Malassez are remainders of Hertwig's sheath, and, therefore, are postembryonic cells. The radicular cyst developing from them is benign, while the multilocular cyst develops from the anlage, which is made up of embryonic cells and is, therefore, on the borderline toward malignancy.

E. C. Hume, Louisville, Ky.: There are a few points that I wish to emphasize, in the

order presented. 1. In the diagnosis of cysts, I find that aspiration of the cyst fluid is helpful. Especially is this true of the larger cyst. Bloody fluid aspirated from a cyst cavity is strongly suggestive of sarcoma, and when this condition is encountered, careful sectioning should be done to see if malignant degeneration has taken place. 2. If granulomas were removed at the time of extraction, we would find fewer of these destructive cysts. 3. A more thorough examination of our patients, with properly made and correctly interpreted roentgenograms, will enable us to detect cysts before large areas of bone are destroyed. In all cases in which teeth do not erupt at the normal time or teeth are apparently missing or have been removed, and the process presents an abnormal contour, full mouth roentgenograms should be made and the existing condition determined. 4. I agree that the treatment of cysts is surgical, and that the utmost care should be exercised in the removal of the capsule when enucleation is attempted. If this capsule is not completely removed, the cyst will recur. Every effort should be made to conserve good teeth and their investing tissues. In large cysts, I often aspirate a considerable amount of the fluid before cutting down on the capsule; which enables me to detach the capsule more easily from the bony wall. There is less likelihood of rupturing it, and this procedure makes it possible to work through a smaller incision. I do not employ the Partsch method very often as patients complain of the deformity being greater. The crater left after this operation is annoying and, in some instance, patients insist on the cavity being filled by a graft. 5. I believe that local anesthesia is the anesthesia of choice in this work, regardless of the size of the cyst to be removed. 6. In cysts in which the outer plate of the mandible is destroyed and the overlying soft tissue appears swollen, I find that this swollen appearance can be easily overcome by using a through and through silver wire suture with lead plates. If the inner plate of the bone is heavy, it may be necessary to make an opening for the needle through this in order to get the lead plates or buttons in the most advantageous position for bringing the desired pressure on the distended tissue, in order to reduce it to normal position.

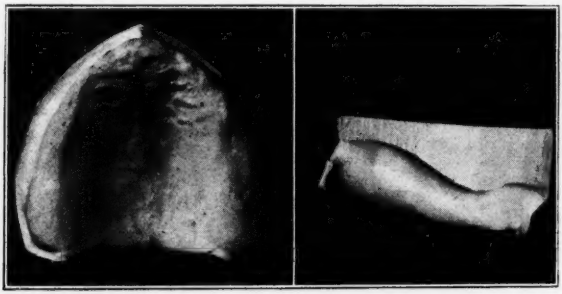

Fig. 19.—Plaster casts of case shown in Figures 11 and 18, showing preservation of bone structure and perfect symmetry of ridge.

Truman W. Brophy, Chicago, Ill.: Dr. Aison has not only shown us the importance of this subject but also the importance of making the diagnosis. I am satisfied that many patients carry a cyst along for many years without being conscious of it, and often the condition increases in seriousness with the passing of time. Consequently, it is necessary that the greatest care be exercised in the examination of patients and consultation should be called for whenever the operator or attendant is uncertain of the condition. I think that consultations should occur more frequently than they do. I have known of young men just starting out who overlooked these conditions entirely. Dr. Aison has made an impression on this audience that will not be effaced. These men will look more deeply into these things when a patient comes in asking why this swelling is here, and why this tooth seems a little loose. I would like to take exception to a statement

made about devitalized teeth. We have few devitalized teeth. We may have teeth with devitalized pulps, but that does not mean devitalized teeth, as long as the pericementum receives nutrition, and the cementum and the canaliculi are nourished. Even though the dentin has lost its source of nutrition and vitality, the tooth is not a "dead" tooth. I wish that we could abandon that impression and have only teeth with conditions such as they are, with devitalized pulps, abscesses forming, and so on. So long as the pericementum lives and the cementum is nourished, the tooth is not devitalized, and it may be made useful for many, many years of life, possibly to the end of life.

M. D. Wolfsohn, Buffalo, N. Y.: I should like to ask Dr. Aison what he would do in case of a large cyst in the mandible in which he encounters the mandibular nerve, as to whether he would extirpate that nerve, or leave it there.

H. M. McFarland, Kansas City, Mo.: One point possibly was not brought out, and that is the fact that these granulomas, so-called, are filled with blood vessels. I wish to emphasize the necessity of removing these granulomas whether they are caused from pyorrhea or from the presence of pus sacs at the roots of the teeth. I should like to ask Dr. Aison if, in his opinion, the roentgenogram to the left in the series in which there are six, showing the lower incisor vital, and in which there was a large area, the condition developed originally as an infection from a pyorrheic condition. The thing that impressed me very much, and to which I wish to add emphasis, is that, in all cases, we should remove the disease condition at the time that we remove the teeth.

R. H. Snyder, La Salle, Ill.: I should like to ask Dr. Aison how he can tell by roentgen-ray examination where the pus sac of an ordinary abscess leaves off and the cyst begins—a small cyst or abscess.

Wilbur R. Amy, Toronto, Canada: There are two questions I should like to ask Dr. Aison. When does he extract the teeth? Before he opens up and examines, or after? This seems to me a very important thing. It is an exceedingly difficult matter to ascertain from a roentgenogram just what teeth to extract until you have made investigation. There is another point: Is it not better, in some of these cases, especially when we have an extensive involvement, and especially in the maxilla, or in some cases in which we extract the teeth at the time, and in which the whole lingual aspect possibly is involved, as well as the lateral, to leave those teeth, and remove the cysts, or one or two, until such time as the maxilla has strengthened?

M. R. Howard, Denver, Colo.: I would like to ask if in the enucleation of a cyst, Dr. Aison has ever observed evidence of an improper operation or in an operation on the cyst, any association with osteomyelitis or

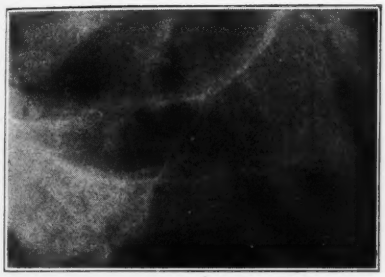

Fig. 20.—Case shown in Figures 11, 18 and 19, taken two years after operation; showing complete regeneration of bone.

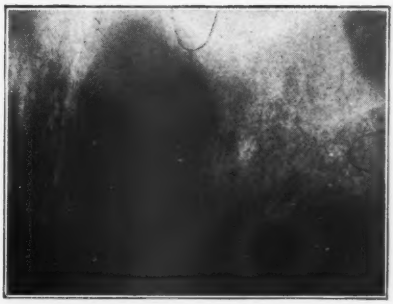

Fig. 21.—Bone destruction resulting from cyst formation. For some time prior to operation, there was some doubt as to the diagnosis as the roentgenogram revealed no well defined and sharply outlined walled-off area. Subsequent findings, both clinical and laboratory, fully corroborated the diagnosis of cyst.

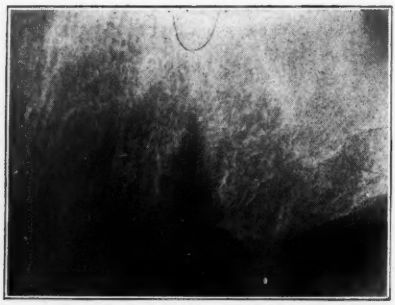

Fig. 22.—Case shown in Fig. 21, taken two years later. There is no loss of symmetry, and complete regeneration of bone has taken place.

complication with osteomyelitis after an operation for the removal of a cyst?

Joseph P. Wahl, New Orleans, La.: Dr. Blum brought up the subject of the Partsch method of removing cysts. He asserted that cysts do not recur if thoroughly enucleated. It is because of this fact that I could never see a good reason for using the Partsch method, because with this method the cystic wall is not thoroughly enucleated. Thorough enucleation is, in my estimation, the only way to prevent the reoccurrence of a cyst. It has lately been brought out that a tooth does not always prove its vitality by the test we give it. It is claimed at present that an acid condition in this pulp chamber will produce a false interpretation of vitality. If that is the case, there is only one method to use, and that is to follow up the test by the actual application of a small bur, or something of that kind, to make a true test of the vitality of the pulp. In looking at a roentgenogram, it is very hard to determine the number of teeth that are involved in any particular cyst, because a cyst may appear to involve several teeth, and when we begin to remove them, we find that it does not do anything of the kind. Therefore, it is very important to find the number of teeth really involved by this particular cyst.

Dr. Aison (closing): I hope it will be possible for me to just touch on the various points that have been brought out, and some of the questions that have been asked me. It would not be fair to this audience, I believe, for me to attempt to go thoroughly into the written discussion of Dr. Blum, just read, for the reason that it is quite lengthy, and covers some of the phases which have already been elaborated upon in my paper. However, I beg your indulgence for the time it will take to answer Dr. Blum's opening remarks; namely, "Dr. Aison apparently misleads the audience when referring to so many vital teeth in the vicinity of the cyst, etc." If any of the audience here present, besides Dr. Blum, received the impression that the statement made in the paper, or the slides shown on the screen on the subject of vital teeth in the vicinity of cysts, were misleading,

Fig. 23.—Dentigerous cyst in the area between the left upper central incisor and the right first molar, involving the floor of the nose and maxillary sinus. The presence of a pulpless but well filled lateral incisor is merely coincidental and in this case of no significance etiologically.

no expression of such opinion was heard of. I stated in my paper and reiterate now that radicular, root or periosteal cysts in the jaw are frequently found not only where there is chronic infection with or without teeth or roots in the region, but also at the site of perfectly vital teeth. These, as far as we know now, are brought about by trauma which induces a gradual but progressive stimulation and proliferation of epithelial cell rests when they are present, and ultimately results in cyst formation. I have shown here slides clearly illustrating these conditions, which are not at all uncommon and are within the experience of every clinician. In the cases in which this type of cyst is found in the edentulous jaw, there is every reason to believe that chronic residual foci of infection are the etiologic factors. In these cases as well as in the case of cyst of traumatic origin about vital teeth, the phenomenon is that, instead of the usual pathologic changes following infection or injury, such as osteitis, osteomyelitis, caries or necrosis of bone, there is cyst formation with all its attendant characteristic clinical and histologic features. Dr. Blum says that granulomas (that is, the nature of the structure histologically) can only be determined by the microscope. That is correct. If one wishes to be absolutely certain, wishes to have a laboratory corroboration, the thing to do is to have it examined under the microscope—not only a granuloma, but any other tissue. It has been my practice, whenever I remove a cyst or a large granuloma, to have it examined immediately in the laboratory, in order to determine the exact nature of the structure. However, the clinical findings are very important, and one may determine the nature of the disease that he deals with by clinical observation and then have the clinical diagnosis confirmed by the microscopic findings. I do not think that it is a difficult task to tell whether the lesion is a granuloma or a cyst. The roentgen-ray is an important but not a deciding factor in the diagnosis. The appearance of a granuloma is quite different from that of a cyst. It was not quite clear to me what Dr. Blum meant when he said that when the cyst involved the floor of the antrum, it is a condition of the antrum and not that of the teeth. What I am trying to point is this: frequently, the cyst develops about the upper posterior teeth and involves such a large area that is causes atrophy of the floor of the antrum. The pressure from the cystic contents not only thins out the bone forming the mesiodistal boundaries and buccal and palatal plates of the jaw on the affected side but also thins out the floor, which is a very light structure, and obliterates the antrum by gradually forcing the floor upwards; or a complete breaking through of the floor takes place as a result of pressure necrosis, at which time the cyst invades the sinus itself. When the cyst sac is completely enucleated,

Fig. 24.—Dentigerous cyst with coronal portion encapsulated, the roots being imbedded in the surrounding bone. (Leo Winter.)

Fig. 25.—Formation of dentigerous cyst in patient aged 14 years.

we find that the mucous membrane lining the antrum is intact, and it is well to leave it so. It is well not to interfere with it. It it well to enucleate the cyst and let the antrum alone, and it will heal. Dr. Blum said something about the two cysts of one mandible which, according to his statement, the roentgen-ray did not show. I do not see why he could not see that. The film shows the right side on one slide and the left side on the other. The slides were particularly good, I thought, and revealed the pathologic process quite clearly. The subject is an edentulous lower jaw with a cyst on the right, and a cyst on the left. The history, which is quite important in all of these cases, showed a recurrent swelling over a period of many years. Clinically, there was that parchment-like distension of the bone that gave on digital manipulation. There could be no mistake as to the nature of the pathologic process. I agree with Dr. Hume that local anesthesia is, in these cases, the anesthesia of choice. It is much pleasanter to work when your patient is able to give you cooperation and you can take your time and do the operation well. In very apprehensive patients, the use of local anesthesia is sometimes precluded; and in those cases, I use a general anesthesia. Dr. Wolfsohn asks what I do with the mandibular nerve. I have had cases of cysts in the lower jaw in which the cyst was so large that it encroached on the mandibular nerve, and the blood vessels. It is not a difficult matter to lay these structures aside and enucleate the cyst, being careful not to disturb the other structures. The cyst itself has a tendency to push the nerve and vessels to one side. I have shown in one slide a condition exactly like that. I usually take a pair of tissue forceps or a tenaculum and pick up the nerve and the blood vessels without disturbing them. In fact, one has to do that in order to enucleate the cyst and not injure the other important tissues. That is not a difficult matter. Dr. McFarland said something about blood vessels in the granuloma and the general structure of a granuloma. I would say this: it is not anything new. Everybody knows that the granuloma is composed of small round cells, polymorphonuclear, endothelial leukocytes, fibroblasts, capillaries and fibrous tissue, and sometimes masses of epithelial cells. Usually on microscopic examination, you will find streptococci, and if a secondary infection has taken place, you will find staphylococci. After a granuloma is removed, the surrounding bone tissues are stimulated by gentle curettage; the cavity fills in with blood, which finally becomes organized, and new bone formation eventually takes place. I might say again in this connection that, in all these cases, we do not depend entirely on the roentgen-ray findings. This would be fallacy. I wish to see the patient and make a thorough clinical examintion of the case. I wish to have a complete history of the case, so that the procedure, surgical or otherwise, will be guided by the findings and the history. No careful man depends on roentgen-ray findings alone. This is apropos of the question as to how I determine whether there is a cyst or some other condition present. I take everything into consideration that I possibly can: history, roentgen-ray findings, ocular examination, aspiration, etc. Dr. Snyder asked where an abscess ends and the cyst begins. The findings, clinical, roentgen-ray and laboratory, are entirely different in these cases. Sometimes, it is not an easy matter to make a definite diagnosis before the operation is performed. Sometimes, as I have shown in some of those cases on the screen, there was considerable doubt as to whether there was a cyst present or not, but subsequent findings, both clinical and laboratory, bore out my conviction that the condition was a cyst. My reason for believing this was the clinical picture, the distended, thinned out and bulging bone wall, and the fact that there was, on pressure, a small fistulous opening or sinus. On pressure, we could get a copious discharge of brown fluid, which is typical of cyst formation. If there were an abscess, we would get pus. Of course, we get some pus in cysts, but the thinned out, parchment-like wall is very characteristic of a cyst. In other pathologic processes of the bone, we have caries or necrosis, and an entirely different picture, both clinical and roentgen-ray. Dr. Amy asked when the teeth are extracted. That is quite important. I would advise the extraction of these teeth at the time when the cyst is enucleated. Usually, it is best to remove the teeth and remove the cyst at the same time. Whenever the clinical findings do not agree with the roentgen-ray findings, I abide by the clinical findings. Dr. Wahl said that if there is thorough enucleation of the cyst,

there will be no recurrence. That is so. I have not had a case in which there was a recurrence after thorough enucleation of the cyst. By the Partsch method, the cyst wall assumes the characteristics of the associated tissues, and it fills in, but not well, not completely. But it is the lesser of the two evils. When we have a case like that I have shown, in which half of the mandible is involved, I doubt the wisdom of such a procedure as complete enucleation of the cyst. Of the two, I would choose the Partsch method. Dr. Howard asked about osteomyelitis. That may be a complication if the tissues were traumatized badly at the time the cyst was enucleated or acute secondary infection had set in. That occurs as does any other complication, and we have to do the best we possibly can. It may be followed by necrosis and some pieces of bone may eventually become sequestrated. It is then removed.

CLINICAL CONDITIONS IN THE CHILD'S MOUTH*

By HAIDEE WEEKS, D.D.S., New Orleans, La.

THAT there is "nothing new under the sun" we quite believe, when we find the same experiments being performed in different parts of the world, at the same time and for the same purpose.

There is nothing new or startling in what I have to say to you today. Many of you have heard almost the same things before. Today, there are more definite conclusions than have been arrived at before. As far as can be ascertained, some successful results have been attained by application of various treatments. Observations have been made and recorded which have been diagnostic aids to the medical man. This thesis, in my opinion, covers merely what is of most importance in diagnosing the clinical conditions in the child's mouth.

An appreciation of the principles of child psychology, which is fundamental in the diagnosis of conditions in the child's mouth, is more or less difficult to formulate. Results are absolutely predicated on an understanding existing between the operator and the patient.

I shall take some of the cases which are presented to us in the clinic or in the daily office routine.

The child of from 8 to 16 months is brought in suffering with a severe local inflammation of the soft tissues of the mouth. On examination, we find small vesicles about 2 mm. in diameter surrounded by a reddened zone. Some of these have ruptured, forming ulcers with grayish bases and bright red margins. The ulcers are sunk into the tissues, and the slightly indurated margins stand up above the surrounding areas. They most frequently occur on the margins of the tongue and the inner surfaces of the lip and cheek. These attacks accompany a nervous indigestion, and the child refuses to eat on account of pain. A hyperemic condition can be noted at a glance, besides the other phenomena accompanying the inflammation.

The ulcers can be touched with silver nitrate, and a salt, soda and borax mouth wash used. The patient should be referred to the pediatrician for further diagnosis, if the local conditions persist.

*Read before the Section on Mouth Hygiene and Children's Dentistry at the Midwinter Clinic of the Chicago Dental Society, Jan. 25, 1928.

Thrush or parasitic stomatitis is seen in very young children. In unclean mouths, it spreads rapidly, especially when catarrhal conditions of the mucus membranes are present, and acid fermentation of food remnants is permitted to occur.

The eruption of the teeth is a physiologic process, but it is nearly always accompanied by disturbances of function which are pathologic. Faulty nutrition, undue density of the overlying tissues, or other complicating circumstances may interfere with the process of dentition, and we may encounter complications which even endanger the life of the child.

PREVENTIVE ORTHODONTIA

At the age of 3 years, if the child is normal, he should show a separation of the teeth. This is Nature's accommodation for the permanent denture. If no separation has begun, a rubber tongue should be given the child to chew and pull on. The tongue is made of a piece of inner tube 5 inches long by 1½ inches wide. The end which the child places between the teeth has the corners rounded, the other end has a hole in it so that it may be hung up with the toothbrush.

The rounded end of the rubber tongue is placed between the jaws, and the child is instructed to bite hard while it pulls the other end. The tongue is placed in three positions; first, between the upper and lower teeth on the right, where it is pulled twenty-five times; then, between the incisors, and then between the upper and lower teeth on the left. In each position, it is pulled twenty-five times. This should be done when the child brushes its teeth on retiring.

By this means of prevention, we have saved children from the discomfort of wearing appliances. It has worked successfully in the clinic, where orthodontic treatment would have been impossible, as well as in the private office.

We have had cases of malocclusion on one side, in which the rubber tongue was used only on that side, and have had successful results.

In cases of calcium deficiency, and cases in children who are extremely nervous and in which orthodontic appliances would have been impossible, the tongue has been successfully used.

SYPHILIS

In the examination of the patient, we are able to make the diagnosis by classification of conditions. Abnormalities of size, shape and color of either the deciduous or the permanent teeth, or of both, may point with directness to the existence of serious general disease at some period previous to the eruption of the tooth. It is often a matter of considerable surprise to the pediatrician to get this information first from the dentist. It frequently happens that the parent has overlooked this factor in giving the child's history to the physician.

In my experience, retarded absorption of the deciduous roots is one of the most important diagnostic factors encountered in the mouth of the child. The explanation of the cause is this: The area in which it exists, or the time that it is found, very often points the way to a positive conclusion regarding a vital abnormality existing in the child's general health.

Whenever delayed absorption is seen, a roentgenogram should be made. A positive Wassermann reaction may be a great help here in confirming a diagnosis of hereditary syphilis. After years of experience, I place much more reliance on conditions as seen in the child's mouth than on the laboratory findings. In no department of medicine, not even except-

ing dermatology, are the indications of existing syphilis more positive. It is to the dentist that these patients come before consulting a physician, and it is imperative that he, too, be on his guard as to the existence of syphilis in the patient. In numbers of cases in which the positive diagnosis was easily made by examination of the mouth, clinical signs and laboratory findings were lacking.

The typical picture of a child with a pasty complexion, coarse, dry hair, and "saddle nose," who is indifferent to his surroundings, and stunted in growth and intellect would, in all probability, be recognized by a practitioner as that of a patient suffering with hereditary syphilis. His lymphatic glands may be enlarged, all or just one group of glands. On opening the mouth, the ducts are seen to be functioning; the opening and closing of the jaws are normal. The lower anterior teeth are even and slatlike, with the spaces between them as wide as, or wider than, the mesiodistal width of the teeth. An upper labial frenum and boxlike anterior teeth are seen. As a rule, in cases of this type, the deciduous molars are large, well-shaped teeth. The first permanent molars are in position, and a marked fifth cusp on the lingual of the upper permanent molars is seen. The tongue is very red, with deep fissures, but, in some cases, may not be changed at all. In most cases, it is thicker and shows the imprints of the teeth on its edges. Many folds and furrows transverse the surface of the tongue; which gives it either a flattened form, or, at the edges, a pulled out or fringed appearance. The most important and characteristic symptom is the thickening of the epithelium. The thickened epithelial spots, as they spread, assume ring and bow-shaped forms which have a more or less bright red center, sometimes very smooth. Sometimes, these plaques are raised above the normal mucous membrane and are yellowish gray. Rapid change is particularly characteristic of this condition. Sometimes, they disappear for a while. The aspect of the tongue is never normal. These rapid changes in shape and form are more marked in the younger child. The condition lasts during life. When we see a condition of this kind, we ask for a Wassermann test. It may or may not be positive. A simple geographic tongue, with no other evidence, is not sufficient indication of syphilis. To determine the presence of this, we must seek further.

In eleven cases of fused teeth, ten were of the lower anterior teeth. Only one was of the upper anterior teeth. Of the eleven patients showing fused teeth, nine were proved to be syphilitic. In seven of the cases, bone involvement was evident; as were club feet, "growing pains," arthritis and hip disease. Mental deficiency was frequently found.

In one patient, mentally defective, there are now five lower incisors. After specific treatment, the child is becoming normal in point of intelligence.

Fused teeth occur quite frequently in the cases which present unmistakable signs of syphilitic disease, and I am impressed with the fact that, in our records, this anomaly occurs usually on the right side, and seems to be confined to the lateral incisor and cuspid. There is no explanation to offer for this phenomenon, and it is mentioned only in passing. The frequency with which fused teeth have been seen in syphilitic children inclines us to consider them as a sign of no insignificant value in summing up the diagnostic points in the given case. In cases of fused teeth, there are nearly always other abnormalities and malocclusion. If the malocclusion is not noticeable in the

deciduous teeth, it most probably will develop later.

Indeed, it cannot be too strongly emphasized that the dentist sees perhaps the most positive evidences of hereditary syphilis that are presented in any field of medicine, and he must learn to recognize these signs as they appear. This necessity is so obvious that further comment on this point seems useless. An orthodontist may save himself mortification by learning to recognize hereditary syphilis when it is manifested in the mouth, refusing to undertake orthodontic treatment until treatment of the disease is, at least, well under way. Again, we must insist on diagnosis as the fundamental fact in all medical and surgical undertakings.

After referring to a diagnostician one of the cases of delayed absorption and eruption that we have been watching for several years, a skull picture showed a lack of the frontal sinus.

SCURVY

Patients between the ages of 2 and 6 years often show a hemorrhagic gingivitis. The gums are swollen and bleed easily, and at times cover the teeth. Ulceration about the necks of the teeth, with a dark bluish ulceration on the tissue overlying roots of decayed teeth, is seen. Frequent hemorrhages from the mouth and nose are noted. The patient often will be carried by the mother and placed in the chair, or will limp into the office. There will be noted a swelling of the large joints, especially about the knee and ankle, marked pallor and flabby muscles. There is always a history of bad feeding, and usually a lack of diversification of foods. The symptoms are immediately improved by an antiscorbutic diet of orange juice and canned tomatoes, and a thorough cleaning of the mouth.

GREEN STAIN

Many children of from 8 months to 9 years come in with a green stain on the gingival margins of the teeth.

In mouths in which no toothbrush has been used, we will find a heavy mosslike covering extending from the gingival toward the incisal edge of the teeth, with the darkest olive stain toward the gingival margin. An application of an iodin disclosing solution will reveal the amount of starch in the débris covering the teeth. After scaling, we may cleanse the teeth of everything but the green stain. In cases in which the toothbrush has been used, we may still find the green stain. The stain is no indication of uncleanliness or poor care of the mouth. We find it as a well defined line on the gingival margin, on the buccal, labial, and lingual surfaces on the upper as well as the lower teeth. It has been found in families of six children ranging in age from 2 to 12 years, and in the fathers and mothers of the families.

The green stain is also found in the mouths of children who have pyelitis. We have never seen a case of pyelitis without the green stain. The green stain is found in the mouths of adults who have well kept mouths, and are apparently in good health. We have never found the stain on artificial dentures as we often find calculus.

We will find that the child who has the stain has not had a balanced diet. If the small child is being given the juice of one-half orange a day, twice the amount of orange juice will probably prevent the stain.

In my tests of more than 300 cases showing green stain, in both children and adults, 95 per cent of the patients were not able to differentiate between bitter and acid. A child or an adult will not eat or drink something which

is distasteful to him. One of my patients on whom these tests were being made told me he could not eat salads. He could not sit at table if there was vinegar on the table, it being so distasteful to him as to be nauseating. He could not eat a lemon or an orange. He could not differentiate between quinin and lemon juice. In children, the acid is bad tasting and so is quinin, and they cannot make the distinction between sour and bitter. Mothers will say that the baby "spits up" the spoonful of orange juice, but takes prune juice readily.

Patients in whom we find the green stain usually have a periodontal membrane that is red and spongy, and, as a rule, there is a susceptibility to ulcerative stomatitis. If we make tests in the cases of a man who had "trench mouth" in France, and who still has a moderate degree of ulcerative stomatitis, we find that the green stain is there in association with the lack of vitamin C in the diet, with a distaste for acids, and an inability to tell the acid from the bitter.

CALCIUM DEFICIENCY

Many of us see in children the recurrence of decay, which is sometimes most discouraging. A child will return in from eight to ten weeks with two or more cavities. The enamel is soft enough to be removed with a spoon. We have noted that the saliva in these cases is nearly always viscid. In sixteen cases of white decay, eleven cases were associated with hypothyroidism. One patient had no eyelashes or eyebrows. On the other hand, one was 6 inches taller than normal, and her permanent teeth erupted four years earlier than normal. This child is seen once a month. Her father, who is a physician, is, of course, quite concerned over her condition. She has had the same food, care and attention as the other five children in the family, and yet the softening of the tooth structure is not found in any other member of the family.

This white decay is similar to that we often find in the pregnant woman in the gingival region, and in partially erupted molars. Nursing mothers also at times show these white lines at the gingival margin.

The opaqueness of an apparently sound tooth is sufficient warning to try to find a break in the enamel. It may be found just below the contact point. Sometimes, three-fourths of the crown of the tooth may be scraped away without any inconvenience to the patient, and it may be done as easily as scraping a piece of chalk. The pulp has receded beyond the area of decalcification. The recession of the pulp is in proportion to the destruction of the tooth tissues. There is no discoloration whatever.

In the same mouth, we may have caries, the discoloration, breaking down of the dentin supporting the enamel and the leathery discolored condition of the dentin over the pulp. The patient will experience inconvenience from sweets getting in these cavities, which are most minute in size. On the other hand, in the teeth which are three-fourths destroyed by white decay, he will experience no inconvenience either from sweets or from extremes in temperature.

The white spots that we often see on areas on the eruption of the permanent teeth are due, we are taught to believe, to the lack of calcification or to disturbed metabolism of the parent or child during the formation of the respective teeth on which it was found.

In cases which we have been carefully observing for fourteen years, many of the patients have had perfect deciduous dentures, and the erupted first perma-

nent molars are in perfect condition. Then, for some reason (for determination of the reason, I am here before you today) the teeth are attacked and opaque areas appear.

Different writers have proved, with experimental animals, that, by certain diets, certain conditions can be produced. The two most important inorganic salts necessary for human skeletal growth are calcium and phosphorus. Not only must calcium and phosphorus be supplied in correct proportions, but also certain conditions in the body must govern their utilization. Telfer showed that, by feeding a ration deficient in lime but containing an adequate supply of phosphorus, he could produce the soft, spongy bone which bends on pressure, such as that found in rickets. By adding the necessary calcium in the form of calcium lactate, normal skeletal development recommenced. Sunlight and the vitamins are necessary.

The effects exerted by the secretions of the ductless glands have been, in my opinion, the most probable cause for this deficiency. In numbers of cases that we have had under observation for twelve years, and in which we were able to have basal metabolic readings made, 90 per cent of patients showed a hypothyroid condition. In the basal metabolic rate in most of these cases, the reading was a minus. Doses of parathyroid or thyroxin were given in proportion to the minus reading. With the dosage of thyroxin or parathyroid, whichever was indicated, a quart of milk and 15 grains of calcium lactate were given daily.

This should be the greatest study that we have on our hands today, as the problem is so enormous and our knowledge so meager.

Medical and dental science is teeming with aids to diagnosis of the etiology of disease. Many times, the diagnosis has been made so late that it is of no value to the patient. If every condition of systemic disease produces certain changes of the dental tissues, to what extent may we recognize changes in the diagnosis of the conditions of systemic disease?

1207 Maison Blanche.

A SURVEY OF THE FIELD OF PARTIAL DENTURE PROSTHESIS INCLUDING CROWN AND BRIDGE WORK*

By HART J. GOSLEE, D.D.S., Chicago, Ill.

THE practice of the specialty of partial denture prosthesis, including crown and bridge work, today is rapidly becoming more or less simplified and standardized. A few years ago, all of our methods were purely empiric. Almost every practitioner who made prosthetic replacements of any kind had his own ideas and his own methods of procedure, and usually followed the same general lines in all cases. He felt that he was obtaining results far more satisfactory to his patients and to himself than were previously possible with the usual type of partial denture in the form of "plate work"; hence, he rested complacently in the belief that he was ren-

*Read before the Section on Partial Dentures at the Midwinter Clinic of the Chicago Dental Society, Jan. 25, 1928.

dering good, efficient service, and giving the best that was in him to give.

There were some who were not content to leave well-enough alone, who were ambitious and progressive, and who recognized greater possibilities and higher ideals. Progressive development resulted, until now it may be said that this specialty stands upon a firm foundation and is recognized as being one, if not the first, of the three most important branches of dental art, the other two being full denture prosthesis and dental ceramics.

This wonderful progress and the splendid improvements made are to be attributed largely to two increasingly important factors. The first factor is to be placed to the credit of that great and revolutionary contribution to dental art, the casting process. This wonderful achievement has now developed to a point far beyond even the most sanguine expectations of its inventor, and to a point where it is now comparatively easy to observe the basic requirements of accuracy of adaptation, restoration of function, strength, sanitation and esthetics in all forms of crown, bridge and partial denture replacements in a better, quicker, more certain and more simple manner than was previously possible.

CROWN WORK

In the replacement of the crowns of the teeth as single units, but few methods are or need be followed today, and the technical procedures involved in each are rapidly becoming standardized.

The Porcelain Veneer Crown.—The porcelain veneer or "jacket" crown remains in a class by itself as the one outstanding ideal method of replacing the crowns of teeth. Its general use is indicated in the replacement of the ten anterior teeth in both arches, and, not infrequently, the replacement of the first molars.

The lack of technical knowledge or of adequate skill on the part of the dentist or the absence of the necessary equipment to do porcelain veneer crown work in one's own office is no longer an excuse for not doing this class of work. The modern dental laboratory and the services of special ceramic technicians are now available everywhere, and are prepared and properly equipped to handle the purely laboratory part of porcelain work of any kind in a skilful manner. Hence, the dentist need only qualify in the technic of root-preparation and impression-taking to be able, with the assistance of his technician, to render this important and esthetic service to his patients. And no one should feel in any way embarrassed in consigning this class of purely technical work to the dental laboratory or to the ceramic specialist, because these branches of dental art have become an important and doubtless permanent specialty of dentistry.

The Dowel Crown. — The dowel crown, the next most generally useful type of replacement for anterior teeth, has a broad field of usefulness in cases in which the natural crown and the pulp have been or must be sacrificed. It may be used either as a single unit or as an attachment for bridgework.

In the construction of crowns of this type, the coping, or base, may be made by casting or soldering, according to individual preference, but, however built, and whether to be used as a single unit replacement or as an attachment for bridgework, only replaceable, cemented porcelain facings or teeth should be used in all cases.

A full, telescoping peripheral band, very narrow, but more or less perfectly adapted to the continuity of the root, is

indicated whenever the root is inherently weak or frail, and in all cases in which the crown is to be used as an attachment for bridgework.

Partial bands may be used successfully by following any of the variations in root preparation which may seem best adapted to the individual case, but are indicated mainly in cases in which the crown is to become a single replacement and not to be used as an attachment for bridgework. The only variation along these lines would be seen in cases of very large, strong and healthy roots.

The dowel for crowns of this type should be made of round clasp-metal wire of a diameter proportionate to the size of the root and yet adequate to the requirements of strength, and should never be notched or serrated. Just previous to mounting, a slight coating of shellac varnish should always be placed over and around the dowel before cementing to place. This precaution in no way interferes with the stability or permanency of cementation and yet affords opportunity for easy removal in the event of necessity.

The all-porcelain ready-made crown with the dowel baked into the body of the porcelain is now practically obsolete. The reason for this is that greater weakening of the supporting root to accommodate the dowel and proper adjustment and placement of the crown is usually demanded than is necessary in the use of crowns with separable dowels. Owing to the increased possibility of fracturing of the roots, especially in such teeth as the upper lateral incisors and first bicuspids, and the four lower incisors, together with the increased opportunity for the development of caries at the line of junction between crown and root, employment of this type of crown is now to be regarded only in the light of a temporary procedure, at best.

Gold Crowns.—Full gold crowns having a well adapted telescoping peripheral band are still used, more or less generally, and, irrespective of the claims of some of our idealistic dreamers, this type of crown remains one of the most dependable and permanent means of replacing the crowns of molar teeth, whether used as a separate replacement, or as an attachment for bridgework.

Partial crowns for molars and bicuspids, such as the so-called "three-quarter" crowns, are useful as single unit replacements in that class of cases in which the buccal wall remains good and strong and, for esthetic reasons, it should be conserved, but otherwise this type of crown is indicated only as an attachment for bridgework.

Among the recent theories promulgated by some whose inclinations run toward idealism to the point of fanaticism, the all-gold telescope crown with a full peripheral band is condemned, and a shoulder crown is recommended instead. There can be no doubt that an abutted joint between a crown and the supporting root is positively less irritating to the gingival tissues than a telescoping, overlapping joint, provided the shoulder is well prepared and the crown accurately fitted thereto, both of which procedures are much more difficult, painful and uncertain than is the telescoping band and the more simple preparation required for it. But with all due consideration of the importance, and indeed of the necessity, of avoiding all or any possibility of gingival irritation, and of thus conserving and promoting the health of these tissues, the gold crown that has a well-adapted, full peripheral band has outlived in permanency, stability and restoration of function any other one

single type of replacement yet used, and will probably always serve as the best and most simple method of replacing the crowns of molar teeth and, occasionally, the bicuspids. Its use, therefore, is not to be condemned even by the most idealistic fanatic, and its past record of service proves the truthfulness of the statement; but correct adaptation, and freedom from gingival irritation, must be observed in its use at all times.

If every dentist could and would develop the skill and follow the splendid technic of Dr. Tinker and others, the shoulder gold crown, either full or partial, would be ideal, but even then it would not be indicated in more than 50 per cent of the cases demanding replacements, and the other 50 per cent could be best restored by a telescoping band. Hence, the practitioner of today who still makes gold telescoping crowns is not practicing obsolete methods; rather, he is serving his patients in the most rational way, and the rational way is always the best way.

FIXED BRIDGEWORK

Notwithstanding the recent and now nearly forgotten commercial tirade against the partial immobilization of the natural teeth and the application of fixed bridgework, this type of replacement remains the one outstanding method of replacing missing teeth in a great percentage of cases involving from two to five, or possibly six, teeth.

The successful application of fixed bridgework from beginning to end is simply a question of first studying the requirements of the individual case and then using it only where it is indicated. When thus used, and when built with carefully adapted attachments supported by good healthy teeth, and with a keen observation of the requirements of sanitation ever in mind, such replacements will afford functional efficiency and comfort perhaps longer and more successfully than any other type of replacement.

In building fixed bridgework, three types of attachments are used: the gold crown, the dowel crown and some form of partial crown or inlay.

Either type of full crown replacement is undoubtedly to be regarded as the most secure and permanent method of attachment, but there is a limited field of usefulness for many forms of partial crowns, and even inlays. The successful application of the latter and the degree of permanency following will depend on the judgment used in the selection, together with such careful and skilful technic as will insure accuracy of adaptation and inherent strength.

Three general types of pontics also meet the requirements of fixed-bridge construction: the replaceable facing for the restoration of the eight anterior teeth, where esthetics is usually the principle single requirement, and some type of combination gold and porcelain, and the all-gold pontic for the replacement of posterior teeth.

The ideal pontic for the replacement of posterior teeth has not yet been designed, but, anteriorly to the second molar, some type of porcelain tooth or facing must be used, for esthetic reasons, and these should always be of the replaceable type. All posterior pontics of whatever type must always be of such shape and form as will permit of and insure sanitation, and should never impinge on or be imbedded in the mucosa.

Porcelain root-end pontics placed so as to rest gently upon the mucosa would be ideal posterior replacements, but the recent fad of projecting anterior pontics of this type deeply into the sockets of

recently extracted teeth is unnecessary and always unsanitary in the end.

REMOVABLE BRIDGEWORK

Except in rare instances where the requirements of sanitation are exacting, the indications for the use of removable bridgework begin where those for fixed bridgework end. In other words, when the case involves the replacement of any great number of teeth, the requirements of health, stress and sanitation are usually to be observed best by some type of removable replacement.

It is difficult to draw a definite line of distinction between removable bridgework and partial dentures, but removable bridgework may be designated as that type of replacement which is retained by attachment to the supporting teeth only, and therefore not tissue-bearing; while partial dentures may be designated as that type of construction which, while mechanically retained by some form of attachment to supporting teeth, *is* tissue-bearing to a greater or less extent.

Many forms of attachments for removable bridgework have been recommended and used, but it is noteworthy to observe that those that have survived are those of the simplest type and those which require the least mutilation, or the least immediate destruction of the natural crowns of the supporting teeth. In this connection, there is positively no place for any type of attachment the application of which will require immediate and extensive destruction of tooth structure, or which will in any way jeopardize pulp vitality or the longevity of the tooth.

The one outstanding thought and ambition of the rational thinking members of the profession today is, and should be, the conservation of the health and vitality of tooth, and pulp and environmental tissues. This leads to the conclusion that the simplest form of attachment that can be used, and the one which involves the least immediate damage or injury to supporting teeth and surrounding tissues, is the one that should be used.

CLASPS

The simplest type of attachment for removable bridgework, and the one which will require the least immediate destruction of supporting teeth, and thus probably afford the greatest degree of permanency in the end, is undoubtedly to be found in the well and properly adapted modern clasp.

Where the supporting teeth are firm and healthy, the least injurious and most successful results today are undoubtedly to be obtained from clasp attachments.

Wonderful and surprisingly accurate and successful results in one-piece castings are now possible, and are but a question of the development of a careful, exact and definite technic. There is also a place for separable clasps attached to the base by soldering, and the use of either method is largely a question of personal preference.

In this connection, it is my firm and honest conviction, based upon close observation and extended experience, that, in clean, well-kept and sanitary mouths, the modern well-adapted clasp will do less actual damage to the natural crowns of the supporting teeth in ten years, or in any given reasonable length of time, than is done immediately by the mechanical preparation demanded for any other type of removable bridge attachment now used. Also, in mouths which are neglected and not kept sanitary, the clasp will last as long as and do no more damage, over any given period of time, than any other type of attachment.

A modern clasp is a narrow, oval-shaped clasp well adapted to the greatest circumferential dimensions, or to what has been designated as the height of contour of the crown of the supporting tooth, and always provided with occlusal and embrasure rests. This type of clasp is to be made best by casting, and must always be well finished and polished on all surfaces.

The second, and essentially the most vital, of the two factors responsible for the progress made is a keener recognition and appreciation of the physiologic requirements and the pathologic possibilities. As a result of the acquirement of this knowledge, and the broader vision which it gave, we have learned to appreciate more keenly the importance of conserving the vitality and health of the teeth, their pulps and surrounding tissues and of observing every precaution to remove and guard against pathologic conditions or disturbances of any kind, and also the importance of making every possible effort to avoid the fatality of mechanical irritation, and to restore, promote and maintain normal function and health at all times.

Master geniuses and wonderfully skilful technicians have graced the ranks of the profession since its birth as a profession, and brilliant ideas and contributions have not been infrequent or unusual during the evolution of this specialty, but the most ingenious and skilfully builded prosthetic replacement, if placed without due consideration of the physiologic requirements and the pathologic possibilities, invites only discomfort, disease and disaster.

Therefore, in the light of our present knowledge, any form or type of replacement which does not subscribe to these requirements to the fullest extent possible is certain to do irreparable injury, and any procedure which is more or less certain to do irreparable injury to the human economy is malpractice of a criminal character, and a practice for which the innocent and confiding patient should be paid rather than the dentist, if the damage done could be measured by dollars and cents.

THE CRIME OF THE DENTAL AGE

The same analogy and the same indictment applies also, and with even greater force, to the radical extraction of teeth.

In this connection, the capricious and devastating wave of radicalism which has swept through the profession in recent years like a riotous cavalcade, and resulted in the loss of millions of good, useful teeth, and the consequent maiming and crippling of the wonderful masticatory apparatus which Nature so ingeniously designed, and which, in normal function, plays such an important part in the promotion and maintenance of health is nothing short of tragedy, and in my opinion might well be designated as the "crime of the dental age."

While it is true that mouth or tooth infection foci frequently are the direct, and many times the contributing, cause of diseases having their origin in streptococci infections, such as functional disturbances, as well as organic lesions of the heart, kidneys, stomach and intestinal tract, together with all forms of rheumatic and arthritic disturbances; and while it is also true that innumerable remarkable—even startling—recoveries from serious, and sometimes alarming ailments have been recorded in the log-book of medical and dental practice as resulting from the extraction of diseased teeth, we learn from a source of unquestionable authority the striking fact that, during all of this period of whole-

sale tooth extraction, there has as yet been no decrease in the percentage of, or mortality from, any of these lesions or disturbances.

It is apparent of course that the real benefits to be derived from the past and present campaign against focal infection directly traceable to pulpless teeth, and its prevention by the extraction of such teeth, will be evidenced more in the coming than in the present generation; yet is the foregoing fact not worthy of serious reflection at the present time, after more than ten years of hasty diagnosis, and radical mutilation of mouths, and is it not time for the medical and dental professions to check up on themselves, place a higher valuation on the teeth of the human family, and recognize and appreciate more fully the importance of correct diagnosis?

Only careful and more or less positive diagnosis should be the predetermining factor in recommending the extraction of teeth at all times, and particularly in the mouths of young patients. But, just who is best qualified to make and assume the responsibility of diagnosis—the physician, the dentist, the roentgenologist or the exodontist? Certainly not the physician, because of his limited knowledge of lesions of the mouth and teeth, and of his lack of special training, even though he is a learned general pathologist. And certainly not the roentgenologist or the exodontist, for similar reasons.

No, the dentist—the one whose mission it is to save the teeth, and to safeguard the health of the human family; the one who is specially trained, and who therefore knows or should know best the intrinsic value of the natural teeth, the damage done by their premature loss, the problem of their replacement, and the possibilities of restoring impaired function, *he* is the one best qualified to pass final judgment. But in all cases in which doubt or danger exists, the counsel and advice of the physician, and of others of experience in the correlated specialties mentioned, should be sought, and will always be helpful.

While I have been regarded as a specialist in the art of replacing missing teeth, it has always been and is still my firm belief that every natural tooth which is not hopelessly pathologic, beyond question or doubt, is an invaluable physiologic asset to its owner, and that natural teeth possess an intrinsic value far above and beyond any type of artificial substitute however skilfully builded.

I also believe that hasty diagnosis has resulted in the premature and irreparable loss of good teeth more often than correct diagnosis and extraction have relieved serious conditions, and hence I cannot but feel that any practitioner of either medicine or dentistry who recommends or practices the indiscriminate extraction of teeth just on general principles, and without first weighing the question seriously and studying the postoperative results carefully, is either a fanatic or derelict in his duty to humanity.

THE FUTILITY OF THE FACE-BOW*

By C. J. STANSBERY, D.D.S., Seattle, Wash.

CONTRARY to correct practice, the title of this paper was written prior to the subject matter, and I am fearful that I overstepped myself in the selection of the word "futility." "Futility," meaning "uselessness," covers a great deal of territory. Indeed, quite paradoxically to my title, I shall begin by ascribing a use for the face-bow.

As detailed in the *Saturday Evening Post,* when our colored friend Florian Slappey, scion of Birmingham Dark Town society, was confronted with the necessity of a railroad journey to a far city, he equipped himself with traveling bag, railroad ticket and a rabbit's foot. The journey and mission safely and successfully accomplished, we again find our colored gentleman back in Birmingham. I think we will all agree that the traveling bag and railroad ticket were necessities befitting the gentleman's style of travel, but how about the rabbit's foot? To this gentleman, the talisman was perhaps of a value and usefulness equal to that of his ticket. It was an essential and necessary adjunct to his journey. It gave him confidence and assurance. Furthermore, could he not point to his safe return and to the successful accomplishment of his mission as conclusive evidence of the efficacy of his pocket-piece? Picture this gentleman deprived of his rabbit's foot. The picture would be one of mental uncertainty if not of despair. I certainly would not be so unkind as to try to convince him of the futility of his rabbit's foot. For those who still think that an articulator must imitate the maxillae and mandible, have condyles, condyle paths and glenoid fossae, have rotation points, centers and axes, all mechanically incorporated within the instrument, I would not rob them of the peaceful assurance that they get from their "rabbit's foot," the face-bow!

All the research work that has been done during the past seventeen years, since Dr. Gysi's articles first appeared, and all the instruments that have been made to endeavor to put the results of this research into practice have had but one goal: to so construct articulators that they imitate jaw movements and to make dentures on them that will function in the patient's mouth as they do on the instruments. These instruments, stripped of their geometric intricacies and adjustments, are but mechanisms designed to hold the casts of the patient's jaws in the same relation as the jaws themselves occupy in the different positions of mastication. At the present time, nearly all adjustable instruments require the use of the face-bow with a technic that, while not extremely exacting, is sufficiently so to be a large factor in deterring all but a few from trying to keep pace with modern denture construction.

The value attributed to the face-bow lies in placing the casts on the instru-

*Read before the Section on Full Denture Prosthesis at the Sixty-Ninth Annual Session of the American Dental Association, Detroit, Mich., Oct. 26, 1927.

ment in the same relation to the opening axis of the instrument as the jaws bear to the opening axis of the patient. It is necessary, in face-bow technic, to locate the point of emergence of this axis on the face. To do this, the operator feels for condylar movement, usually at a point about one-half inch from the tragus of the ear toward the outer canthus of the eye. This is but an approximate position, and it has been proved that this position varies greatly with various degrees of opening. This proven excursion of axial position must be entirely ignored to give any weight to the claim that, with the use of the face-bow, the articulator may be opened or closed *ad libitum* during the procedure of arranging the teeth for centric occlusion. Moreover, the pure opening movement about this axis immediately carries all teeth out of contact; therefore, how can it in any way effect their arrangement for other than centric occlusion? The old plain line hinge, with axis anywhere, will do as well.

I believe that it is axiomatic and must be accepted without argument or proof that there is a correct vertical dimension between maxillary and mandibular ridges. A. K. Parks has explained this correct opening very thoroughly.[1] With this premise, the opening or closing of the articulator from the position registered with the bite-plates is an admission that the bite-plate positions were wrong. Furthermore, any change is simply a matter of guesswork, as the operator has no registrations whatever with which to establish the changed position of his instrument. Also, the registrations for lateral and protrusive positions would not be true as related to this newly opened or closed position of the instrument.

An indictment which I wish to enter against the face-bow is that it is a false prophet: it assumes to locate an axis when there is no axis, or at least only a limiting position to a moving axis. This in itself is not so serious but for the fact that, with the detail involved in locating the so-called axial position, it would be assumed that it was a matter of some importance. On the contrary, it has no value in the functional arrangement of the teeth but gives the beginner an entirely erroneous idea of jaw movement which he afterwards finds impossible to correlate with true jaw positions. The false premise that the axial movement is a fundamental one to functional articulation has been accepted without scrutinizing analysis and has divertingly guided the endeavors of nearly all who have given the movement of the mandible thoughtful study. This is fully evidenced by the number of articulators incorporating it that have appeared on the market within the last few years. This erroneous guidance of the researcher's thought is also directly chargeable to face-bow technic.

The axis as established by the face-bow does one thing and one thing only, and this not an important one: it establishes a line common to both the maxillae and mandible when they are in centric occlusion.

This line, at its best, acts only in a vertical opening, which is not a functional movement. Suppose we have casts mounted on an articulator and in the relation of centric occlusion. The position of the axis is established: it occupies a fixed relation to the upper and lower casts. Let us consider this axis from a

1. Parks, A. K.: The Lost Vertical Dimension, Dent. Digest, 33:451 (July) 1927.

new point of view. Consider the axis to be not a single line but two axes, coincident one with the other, one the axis of the upper and one the axis of the lower, but the two axes occupying identically the same position. A very common movement of the mandible, as pointed out by Dr. Gysi, is this: while the condyle of the balancing side comes downward and forward, the condyle of the working side moves downward and backward. The resulting condition on which I wish you to concentrate your attention is that both condyles moved downward and with them carried the axial line that we have related to the mandible, or the lower cast. Is it not self-evident that, under these conditions, there can be no intersection of these two lines, no point in common from the very instant the movement began?

We find no proponents of axial instruments so rash as to make the claim that if one condyle registers a given direction downward and forward, the opposite condyle will register the opposite direction upward and backward. This is the only condition in which it is possible to have the axis related to the mandible intersect the axis related to the maxillae. The lateral movement of the mandible is necessarily modified by an opening due to cusp height, but this opening movement is not the same opening movement that takes place around the axis. The opening that accompanies the lateral movement is determined by conditions entirely different from axial rotation and to restrict this movement with any foreign condition, such as maintaining a fixed point on the axis, is to develop a movement which does not exist in the patient. I am not antagonistic to axial instruments *per se;* but in their present mechanical construction, they obscurely force the pure or rotary opening into the lateral movement instead of allowing the opening movement which accompanies the lateral to develop independently from its own causes. These causes are the cusp and glenoid fossa slopes. The axis as established by the face-bow acts only in the pure opening movement and is, unfortunately for our purpose, nonfunctional. The error of mechanical construction referred to is that part of this axial position for a nonfunctional movement is mechanically retained in the lateral or functional movements.

This paper will be of no value if devoted entirely to destructive criticism. A constructive substitute for the face-bow technic must be given. In this substitute, none of the exactness nor precision toward which we have been striving will be discarded, but a still higher standard will be set and a more simple technic provided for its accomplishment. As previously mentioned, the aim of all adjustable instruments is to hold the casts in the same relation one to the other as are the edentulous ridges of the patient and to move from one position to another as do the ridges under the control of the masticating muscles. There is no need to complicate our problem with intangible and difficult-to-obtain measurements, rotation points and directrices when the simplest of the fundamental conditions of position can be so easily observed, recorded and duplicated. When we examine our edentulous patient, we cannot see the condyles; we can but make an approximation of the form of the glenoid fossae; we can only hazard a guess, within wide limits, of the location of the elusive will-o'-the-wisp rotation centers. The most obvious thing that we can see, presenting all the information which we require, is the changing

positional relation of the ridges themselves. These relations we can accurately record. We have before us the ridges of our edentulous patient, as our two solids, and check-bites to establish their relation in any position which we may desire to take. These relations may be duplicated by the casts on an instrument if the instrument is free to assume any position which the check-bites may dictate.

The most important relational position with which we have to deal is the position of centric occlusion. The position of centric occlusion is the destination of all masticating movements, and to get there, and exactly there, is a matter of extreme import.

We know that in order to locate and fix any given point, its position must be referred to by three measurements in different directions, usually at right angles to one another, or, which amounts to the same thing, by a given direction and distance from a point previously located. Here, the direction and distance take the place of the three measurements. To fix the position of a given solid, three points must be selected either in the solid or its projections, and each of these three points fixed in relation to previously located points. With this extremely simple geometric basis, known by every one, applied to our cast positions, the problems of articulation will be greatly simplified. It is nothing new and requires no change in one's line of thought to consider the parts of an articulator as projections of the attached casts. To locate the cast, we have but to locate the position of any three points of projection. As all positions are relational, our problem is to establish the relations of the lower to the upper cast. The simplest relational position possible of one point to another results when they are in contact. If three fixed points of projection of the upper are in contact with three corresponding points of projection of the lower, in this relation we have no measurements nor directions to record. This simple contact relationship of projected points of the articulator is selected as the relation to hold the casts in centric occlusion.

In a lateral excursion of the mandible, the mandible takes an entirely new relational position to the maxillae. This new relation is determined by three factors; namely, the cusp slopes, the slope of the right condyle path and the slope of the left condyle path. Each one of these factors is variable and independent of the other two. In the opposite lateral excursion, a new set of three factors holds forth, these, in turn, variable and independent of the first set of factors.

As stated, our problem is to establish the various relations of the casts by recording and duplicating the relations of the natural ridges. The check-bites taken at the time the ridges occupy their various functional positions give us our records. These various functional positions are ascertained by observing an easily visible Gysi tracing.

Next comes the duplicating of these recorded relations and the supplying of a means of movement from one relation to another. When the check-bite of any certain relation is interposed between the casts, the three coincident projection points in the relation of centric occlusion are all moved away from the points with which they were in contact. As the factors which controlled the recorded relation were variable in direction, just so the directions in which these points move away from one another will be variable. This condition demands a mechanism that will register the positions of these three

points in any direction in which they may move and allow a return to their starting point, or centric occlusion.

The universal adaptability of the devices on the three-dimensional articulator to register the positions of these projection points furnishes us with all that is necessary to record any relation of mandible to maxillae, be its relation average or erratic. A three-legged milking stool has the deservedly earned reputation of being able to stand steadily on its legs on the roughest ground; a fourth leg would add nothing. A relation is recorded by three dimensions; why endeavor to add a fourth by using the face-bow?

DISCUSSION

Charles A. Mathias, Louisville, Ky.: The anatomic or adjustable articulator which Dr. Stansbery puts in the same class with the rabbit's foot is one of the outstanding factors in developing denture work. Up to the time of Bonwell, you will all agree that our denture service was very poor. Men have been striving for something better. The anatomic articulator is a material expression of much thought and study; consequently, men have learned more of real denture construction. Every man who contributed to the work did it sincerely, and at a loss of time and money, for the good it might be to the dental profession. I do not know Dr. Stansbery's technic or what kind of an instrument he uses when arranging the teeth, if any at all; for he so completely condemns practically all of them, when he says, "For those who still think that an articulator must imitate the movements of the mandible, have condyles, condyle paths, and glenoid fossae, have rotation points, centers and axes, all mechanically incorporated within the instrument . . ." I know of no anatomic articulator that does not have representatives of condyle and condyle paths. Quoting from Mr. Hanau, "The movements of the articulator do not necessarily reproduce or imitate jaw movements but the movements are equivalent." As for the rotation points, centers and axes: they are not necessarily in the instrument, more rarely ever in it, but at some points outside. The goal that Dr. Stansbery speaks of, constructing articulators to make dentures function in the mouth as they do on the machine, if possible, would be ideal. All of the adjustable metal articulators that I have used require the use of the face-bow. The use of the face-bow may not have the precision of placing a well fitting inlay or porcelain jacket crown, still when it is used properly, the condyle heads may be located within a millimeter or so; and this is very accurate when we consider a radius of about 4½ inches. I can't see how this can deter any man from keeping pace with modern or scientific denture construction. I don't see how we can get along without its use in such instruments as the Hanau, Gysi or Wadsworth. On the other hand, if we are not satisfied with one technic, we can experiment or do such research work as we may desire, to find something better than what we have been using, so long as we are able to prove to ourselves that the new technic is better than the one discarded. The value attributed to the use of the face-bow is that of placing the casts on the instrument in the same relation that they occupy in the mouth anteroposteriorly, when the bite rims are trimmed to correct vertical height and the jaws are at rest in centric occlusion. We can do this with the face-bow, for this is all that it is intended to do. The so-called feeling for the condyle head is not for the head but the posterior portion of the ramus, as the head of the condyle is completely hidden from touch and is always found just below the lower border of the posterior root of the zygomatic arch. The face-bow was not intended to be used except in placing the casts correctly in the articulator in centric occlusion, but the position of the casts greatly affect the line of occlusion or prosthetic curve. We assume we have radii running from the cusps of the lower teeth to the condyles, each tooth describing the arc of a circle in labial motion; then, if these radii are too long or too short, we will experience cusp interference and have dislodgement of dentures. I am glad that Dr. Stansbery brings out the point of lost vertical dimension, as this certainly is a great factor in correct denture construction, and whenever established should never be changed. This gives us the nullified anterior component which Dr. Wadsworth stressed so much, this being one

of the chief factors in stabilizing the dentures. The condyle heads, being a part of the mandible, and the face-bow used to measure the distance from the condyle to the median line, of the lower denture when bite blocks are in centric occlusion, regardless of whether the jaws are opened or closed, these relations never change. The face-bow is a measuring instrument designed for registering the anteroposterior relationship of the alveolar ridges to the condyles when the latter are at rest in the glenoid fossa, as in normal closure. This appliance is indispensable in mounting the casts in true relation to the rotation centers. After several readings of Dr. Stansbery's paper I can't see that the technic he gives is any more exact or simpler and easier than the face-bow technic given by Hanau, Wadsworth and others. There is no doubt in my mind that it has a great deal of merit, Dr. Stansbery being a man of long experience. His paper makes us stop to think. There is no royal road to scientific denture construction, and we all have to work for it ourselves. Regardless of our instrument, whether plain line or anatomic, with or without face-bow technic, we must have a thorough knowledge of the underlying factors in denture construction. Our instrument will give us efficiency only in proportion to our knowledge and skill.

C. J. Stansbery (closing): Unfortunately Dr. Mathias does not seem to have grasped the import of my paper. To make clearer the points which I intend to bring out, I shall review the discussion. I do not put anatomic nor adjustable articulators in the same class with the "rabbit's foot," but wish to make articulators more adjustable and more anatomic by eliminating the use of the face-bow, which stands in the way of this desired result. The articulators and face-bow have been stepping-stones to a more perfect denture construction. I am misquoted in the sentence beginning "Those who still think that an articulator must imitate the movements of the mandible, have condyles, etc." Reference to my paper will show that sentence to be, "For those who still think that an articulator must imitate the maxillae and mandible, have condyles, condyle paths and glenoid fossae, have rotation points, centers and axes, all mechanically incorporated within the instrument . . . " It is this mechanical incorporation and imitation of the physical mandible and maxillae to which this sentence refers. Dr. Mathias knows "of no anatomic articulator that does not have representatives of condyle, condyle paths," but he does know that "the rotation points, centers and axes . . . are . . . at some points outside." The three-dimensional instrument places the condyles and condyle paths along with the rotation points and axes, all outside. The instrument's imitation of functional movements of the patient is controlled and guided by three universal direction devices which have no anatomic counterpart. I join with Dr. Mathias in not seeing how such a simple technic can deter anyone from keeping pace with modern denture construction; but unfortunately the fact remains that it does. It is also true that with the instruments he mentions, Hanau, Gysi or Wadsworth, the use of the face-bow is essential because these instruments are not universally adaptable, the restriction existing in the movement of the working condyle. All the points that Dr. Mathias mentions in defense of the face-bow I will admit are true, except the inference as to its being an essential to practical work. The three-dimensional instrument with its simplicity of technic will open the way to a great many who are not inclined to research. Let me draw an analogy. The electrical engineer in describing a spark plug could fill pages with descriptions of and research on induction coils, high potential voltages, spark gaps, etc., but you can teach a 10-year-old to take advantage of all these with a pair of pliers and a thin dime. So it is with prosthetics. The research men must do a great deal of work whose only practical value is to lay the foundation of a simplified technic that the rank and file may use. This the three-dimensional instrument does, and at no loss, but a gain in precision over past methods.

LOCAL AND MECHANICAL CAUSES OF MALOCCLUSION*

By HARRIS W. McCLAIN, D.D.S., Chicago, Illinois

IN the consideration of any case of malocclusion, the etiology is of utmost importance. Next to recognizing the deviation from normal in the case under consideration, it is necessary that the operator determine, if possible, the factors which are or have been responsible for the arrested or perverted development. The interrelation between them is so close that it is impossible to arrive at a diagnosis without at least some attention to etiology. Failure to ascertain the cause and to eliminate it, if it is still operative, is the most common reason for failure in treatment and for relapse after the retention period. All etiologic factors ultimately manifest themselves as local causes of malocclusion because it is through arrested or perverted mechanical forces that the deformity of the jaws, the irregularity of the teeth and the abnormal relations of the dental arches are produced.

It is the purpose of this paper to discuss causes from the standpoint of individual teeth and their eruption, or their migration from their normal approximal and opposing positions and relationships.

I have nothing new or original to offer, but I submit that those conditions which have been regarded as local and mechanical causes of malocclusion are fundamental and are worthy of great consideration in the effort which the profession is making toward preventive dentistry.

The majority of cases of malocclusion make their appearance before or during the period of transition from the deciduous to the permanent denture. The patient is under the supervision of the general practitioner, who is responsible for the care, maintenance and repair of the teeth and is in a position to discover and prevent local conditions which may contribute to irregularity of the teeth. If he will enlarge the picture so that he may visualize what effect every operation on the teeth will have on the whole denture, he will develop a new and broader point of view on preventive dentistry.

For convenience in discussing them, local factors have been divided into three groups. The first group includes those in which the absence or removal, in part or in whole, of one or more teeth causes the jaw to fail to develop normally in that area and the proximating or opposing teeth to tip or drift. These factors are: premature loss of the deciduous teeth, congenital absence of teeth and loss of permanent teeth other than third molars. In the second group are found conditions which tend to deflect the erupting teeth away from the positions which they normally occupy or to force the teeth already erupted out of the positions which they have assumed. These are: prolonged retention of deciduous teeth or their roots, or the presence of supernumerary or impacted or unerupted teeth. The third group comprises those factors for which the dentist is almost wholly responsible: improper dental restorations including fillings, inlays,

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crowns, bridges and faulty contacts, and also indiscriminate grinding of occlusal surfaces.

Premature loss of deciduous teeth may or may not cause malocclusion. The determining factors are the age at which the teeth are lost, the location of the tooth lost and the depth of the overbite or amount of vertical development of the molar area. The loss of deciduous incisors, especially the upper, is not so important as the loss of posterior teeth. The anterior development of the arches and the growth in the incisor region are largely dependent on tongue function, and the use of rigid upper incisor space retainers is not often indicated. It is indicated usually when more than one tooth is lost and is used to prevent objectionable tongue habits. This observation may apply to lost upper deciduous cuspids when there is a normally developing lower denture. When lower incisors or cuspids are lost, especially in cases in which there is a deep overbite, it is often advisable to place a lingual wire with molar anchorage to preserve the space and the width of the arch. Rigid space retainers between incisors or from cuspid to cuspid tend to obstruct rather than to aid development, and if any are used, they should be of a character permitting adjustment to compensate for natural growth.

The loss of the deciduous molars, especially the second, either wholly, by extraction, or partially, from proximal cavities, is a frequent and common cause of malocclusion. It is extremely important that these teeth be retained and that such repairs as are made in them restore the contour of the proximal surfaces and proper contacts by means of metal fillings. The presence of the full mesiodistal diameter of these teeth is necessary to the forward growth of the jaw, which is, in part, brought about by the force exerted by the developing permanent molars. If deciduous molars are lost by early extraction, suitable space-retaining appliances should be placed without delay. If this is not done, the lower first permanent molar may tip mesially; or an upper first permanent molar will tend to rotate and to tip forward.

In some cases, it is advisable to so construct these appliances that the opposing teeth may strike them in occlusion and thus be prevented from elongation. If the second deciduous molar is lost long before the permanent first molar erupts, it is usually difficult to keep the bite open, and the erupting first permanent molar will migrate forward.

Congenital absence of the teeth is a condition that seems to be transmitted from generation to generation. Although it is one of the puzzling problems in treatment, as a practical factor in etiology it is not so important as either the premature loss of deciduous teeth or the loss of permanent teeth. This is true because the deciduous teeth can usually be kept in position until the permanent denture is completed, in some cases well into the adult life of the patient. When the deciduous tooth is finally lost, the space may be filled with an artificial substitute. In some cases, when opposing teeth such as upper and lower second bicuspids on the same side are congenitally missing, it may be possible to close the space, after extracting the deciduous teeth, soon after the first permanent molars erupt. This cannot often be done without shortening one lateral half of both arches, and thus producing a distortion of the facial lines. The teeth most commonly missing are the upper lateral incisors and the lower second bicuspids, although any number may be absent and, in some cases, no permanent

teeth whatever develop. It sometimes happens that teeth which, on early roentgen-ray examination, seem to be absent, may be delayed in forming and, by later roentgen-ray examination, will be found to be developing. Also, these teeth may be discovered at some distance from the point where they should appear, and comprehensive roentgen-ray examinations should therefore always be made when any doubt exists.

When a permanent tooth, other than a third molar, is lost before the denture is complete, the space tends to close. This disturbs the occlusion of all of the teeth, both upper and lower, on that side of the mouth. If a posterior tooth is lost, the wedging force which stimulates the forward growth of the jaw is removed and malocclusion of varying character results. When the proximating support of a permanent tooth is removed, it is likely to tip, assuming an inclined axis to the plane of occlusion. Through the impact of its inclined planes with those of the opposing teeth, the axial relations of the latter are also disturbed and a malocclusion involving the entire lateral half of the denture may result from the perverted axial stress. If the first permanent molars are extracted before the bicuspids and second molars are fully erupted, the result is usually a closed bite, which causes an undue impact on the incisors. This may drive the upper incisors labially and cause them to separate. It may drive the lower incisors lingually and cause them to be overlapped and bunched; or it may cause the lower arch to occlude distally to its normal relation to the upper. This may be unilateral or bilateral. Angle[1] has truly said, "The interdependence of the teeth is so great that the loss of one or more at any period of their history must have a marked influence upon the remaining teeth." It should be remembered that the removal of permanent teeth without provision for a restoration as early as possible produces mutilation of the denture, usually a marked malocclusion, and ultimately, in many cases, causes the loss of several teeth.

We now come to the second group in which the teeth are either prevented from erupting in their proper places, are deflected as they erupt or are forced out of position after they erupt.

Failure of the roots of the deciduous teeth to absorb, in whole or in part, may cause the permanent teeth to be deflected, as they erupt, into various positions of malocclusion, or to be rotated or even impacted. The incisors and cuspids seem to be more often so influenced than the biscuspids. The absorption of the roots of the deciduous teeth, as the permanent ones develop, normally allows the latter to erupt without interference. Why the roots of teeth absorb, either when there are succeeding teeth erupting or when the latter are absent, is a question which has so far not been satisfactorily answered. Frequently when the unabsorbed deciduous roots are removed, the permanent teeth resume their normal course and erupt in proper position. This does not hold true if the permanent teeth erupt outside the influence of opposing cusps, if considerable space has been lost or if the teeth have been rotated to any great extent. In the latter case, mechanical treatment is nearly always necessary whether there is sufficient space or not. If the tip of the crown of a permanent cuspid is shown by the radiogram to have passed labially or lingually to the root of the deciduous tooth and there is a normal

1. Angle, E. H.: Malocclusion of the Teeth, Ed. 7, p. 93.

development of the biscuspids, it is usually advisable to extract the deciduous cuspid. Frequent check-up radiograms should be taken in cases in which there is any question about interference with the development of the permanent teeth from the roots of the deciduous teeth.

Supernumerary teeth may be typical or atypical and may erupt in any part of either arch or even in the hard palate at a considerable distance from the alveolar processes. Extraction is usually indicated as soon as they are observed; but if they cannot be removed before they erupt without injury to the proximating teeth, it is advisable to wait until they have at least partially erupted. As in the case of retained deciduous roots, supernumerary teeth interfere with the permanent teeth in their eruption, but if removed in time, usually no permanent harm is done, and many such cases need no mechanical treatment as far as results from supernumerary teeth are concerned.

When a deciduous tooth is lost normally and the permanent tooth does not erupt to replace it within a reasonable time, the space may close, and we have very nearly the same picture as that caused by premature loss of a deciduous tooth. The teeth which most commonly fail to erupt are the cuspids, the upper more often than the lower. They may or may not be impacted. The roots of the cuspids are almost fully formed when they erupt, while the apices of the roots of other teeth do not usually form until some time after the crowns are in place in the denture. The growth force, whatever it may be, which causes teeth to erupt seems to cease when the roots are formed, and these teeth lie inert in the process and frequently offer considerable resistance to force applied to move them into place. Impacted teeth, on the other hand, in which the growth force is active and is being exerted to make the tooth erupt even if other teeth obstruct its advance, may produce malocclusion by deflecting other teeth or by forcing them out of the line of occlusion. An actively growing impacted third molar, for instance, may disturb the axial relationship of all the teeth on one side of the denture and, if the proximal contacts are firm, cause an overlapping of the anterior teeth.

One of the contributing causes frequently encountered in malocclusion cases is faulty dental restorations. Every orthodontist has had experience with cylindrical crowns, amalgams without contacts, contour or character, and inlays whose occlusal surfaces have been carved without reference to the crowns of the opposing teeth.

While there has been a great improvement in dental technic in the past decade, there is need for still further progress, especially in the dental work done for children. While it is advisable in some cases in which orthodontic treatment is contemplated or is in progress to place temporary fillings with the idea of placing a permanent restoration after the work is completed, it is my opinion that the permanent restoration should be placed as soon as the need for it arises and it should duplicate the original form of the tooth in contour, contact and occlusal carving. This makes it possible for the orthodontist to place the tooth, as well as its proximating and opposing fellows, in proper relationship. If this is neglected, not only do the improper forms of the temporary fillings hamper the efforts to product normal occlusion, but also the separation and manipulation incident to placing a permanent restoration are likely to cause a relapse. It is needless to say that the absurd forms of some restorations pre-

vent the correction of malocclusion; in many cases, they are causal factors in it. An improper restoration may be as much responsible for a marked malocclusion as the loss of a tooth by extraction. Crowns, inlays, gold foil and amalgam fillings should, in addition to protecting the teeth against the further invasion of caries, be so formed that they will maintain the tooth in its proper relationship to its proximal and opposing fellows.

No other factor in the etiology of malocclusion is more common than improper restoration of contacts of fillings, inlays and crowns. It should be remembered that a tight contact is not always a good contact and that, as a general rule, the original contour of the surface of the tooth should be reproduced in the restoration. Flat contacts or overcontoured surfaces are nearly always bad. The proper buccolingual as well as the proper occlusogingival point should be selected, and as G. V. Black[2] has pointed out, the surfaces should meet at the contact point just as the surfaces of two marbles would touch if placed together. Improperly placed tight contacts are a frequent cause of teeth being rotated.

A too tight contact sometimes causes the teeth mesial and distal to it to be moved out of their positions and may be responsible for the opposing teeth being displaced through the occlusal contact of the inclined planes of the disturbed teeth. An inlay, for instance, with an overtight contact, will seem to the patient to be "too high," and the dentist may grind the occlusal surface of the inlay to make it more comfortable, but the "too high" sensation persists, and is due to inclined planes mesial and distal to the restoration striking opposing inclined planes in other than their usual relation. If the inlay were properly contoured and contact provided which would protect the interproximal tissue, and the inlay were correctly seated, little if any grinding of its occlusal surfaces would be necessary.

Grinding inclined planes of teeth to correct so-called "traumatic occlusion" has been advocated quite frequently in the past few years. It may be indicated in adult dentures, but grinding in the permanent denture of young patients is seldom necessary. If this method were followed out in some cases to the end that there should be no "high spots" on the occlusal surfaces, these would ultimately be perfectly flat. I have seen dentures so mutilated by this treatment that little if any normal interdigitation of the opposing inclined planes was possible, the axial relationships of the upper to the lower teeth being entirely disorganized. Some fundamental physiologic facts are disregarded in indiscriminate grinding. One of these is the tendency of any tooth to continue to erupt until it meets an opponent. If part of its occlusal surface is removed, it elongates to meet the opposing cusps. Another is the tendency of a tooth to move in the direction of the forces applied to it, be they continuous or intermittent, so that a tooth would tend to move out of traumatic occlusion, carrying its supporting structure along with it. In patients below middle age, more harm may be done by grinding than would result from the "traumatic occlusion."

Malocclusion has been discussed here primarily from the standpoint of teeth. It is true that teeth are units of occlusion and that alinement of teeth is one of the ends of orthodontic treatment. Irregularity of the teeth is a symptom of deformity of the jaws, and through the medium of appliances on the teeth,

2. Black, G. V.: Operative Dentistry, Ed. 2, Vol. 2, p. 296.

these deformities may be corrected. Neglect and improper attention to teeth cause many of these deformities. There are many other contributing factors in malocclusion. The dentist who cares for children may do much in the way of prevention by diligently watching for and eliminating any of these conditions which become evident in the dentures of his patients.

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DISCUSSION

J. D. Locke, Grand Rapids, Mich.: Dr. McClain's observations should receive the most serious consideration from dentists in general practice as, on their shoulders, to a great extent, rests the responsibility for the occlusion of the permanent dentition. In substantiation of this statement, one has but to scan over one's model cabinets to find what a percentage of the aggravated cases of malocclusion which are constantly presented for correction would come under the grand classification "preventable." From the standpoint of diagnosis among orthodontists, there are three main classifications: neutroclusion, distoclusion and mesioclusion. There might be but one classification that could take precedence over these from a causative standpoint and which might be productive of any of the three types of malocclusion, and that is preventable. It is this phase of the orthodontic problem wherein enters the general practitioner of dentistry. There is no time in life when painstaking dental operations and scrutinous observation are productive of more beneficial results than during that time when the deciduous teeth are still in position and during that transitory period up to the eruption of the second permanent molars. There is no place, from a dental point of view, where the old adage "an ounce of prevention is worth a pound of cure" can more aptly apply. Yet, in contradiction to this, how often we find dentists who pay but the slightest attention to the deciduous teeth and dental arches, seeming to have but the faintest conception of that vicious circle presented when disturbances appear that tend to interfere with nature's plan in the proper exfoliation of the deciduous teeth and the eruption of the permanent teeth at their proper time and in their proper place. In treating of the preventable causes of malocclusion in the order of their significance, there can be no conflict of opinion as to the fact that the early loss of the deciduous molars, loss of proximal contact and obliteration of occlusal surfaces of these teeth are productive of frequent and varying types of malocclusion which tax the orthodontist's best judgment and skill from the standpoint of diagnosis and treatment. When deciduous molars have been prematurely lost in the lower arch, we may find, on examination, a drifting and tipping forward of the first permanent molars, they usurping perhaps the full space of a bicuspid, with a deep overbite in the incisor area, accompanied by a bunching and overlapping of these teeth. Again, we may find a drifting distally of the lower anterior teeth, sufficient to allow the lower lip to assume a position between the labial surfaces of the lower incisors and the lingual surfaces of the upper incisors, carrying the upper incisors into marked protrusion, forcing the mandible into a distoclusion and compelling the child, in many instances, to develop a distinct mouth breathing habit. If the premature loss of the molar occurs in the upper arch, we may find a drifting forward and rotation of the first permanent molar, as has been stated by Dr. McClain. If this occurs in the upper dental arch previously to the time the incisors have come to their proper height and relation, we may find the upper incisors drifting into a lingual relation to the lower incisors, which, if allowed to continue, may produce a marked mesioclusion, with its characteristic unsightly facial aspect. If the first permanent molar has shifted forward to a marked degree and this condition has been existent until, by roentgen-ray examination, it is shown that the root of the second permanent molar is pretty well formed and this tooth is lying in contact with the distal surface of the root of the first permanent molar, extraction of the second bicuspid has been the practice in our office for some time past. Roentgen-ray examination will show that, coincident with the forward drifting of the first permanent molar, there has been a lack of development mesiodistally in the area posterior to the first permanent molar, and any effort made to move the first permanent molar distally to gain space for teeth anterior to it is done at the expense of the proper eruption of the

second permanent molar. The overretention of the deciduous molars, and this seems to apply especially to the second deciduous molar, will force the oncoming permanent teeth anterior to them into forward positions in the dental arch. If this persists until these teeth come into occlusion with the teeth in the opposite dental arch, it will disturb the relationship of the inclined planes of the cusps of these teeth. The abnormal forward position of these teeth will often cause a lateral pressure upon the incisors, forcing these teeth, which may have previously presented a rhythmic appearance in the dental arch, into a crowded and overlapped position. These cases are often not brought to the attention of the orthodontist until a time when there has been such a drifting of the teeth and the malocclusion has become so fixed throughout the dental arches that it becomes necessary to resort to extraction, and this for esthetic reasons only. In their effort to erupt, the bicuspids may force the deciduous molars into a supraclusion. If this obtains for a sufficient length of time, it may allow the first permanent molar to come into occlusion above their normal height, and, as a result, we may have an anterior open bite case. The early deciduous cuspids may allow the permanent incisors to drift into the spaces left by these teeth. If conditions are favorable, we may find the incisors in one arch drifting to one side and in the opposite arch to the other side, with a disarrangement of the median line in both arches which, if allowed to remain, causes the permanent cuspids to erupt either inside or outside the line of arch. These apparently simple cases present troublesome aspects from a treatment standpoint. Contrary to all that has been said, we still find dentists who, when there is insufficient space for the permanent lower central incisors immediately to assume their proper position in the dental arch, will persist in the extraction of the deciduous lateral incisors. This is nothing short of reprehensible, as there immediately occurs a narrowing of the lower arch between the deciduous cuspids with, perhaps, a complete loss of space for the permanent lateral incisors, compelling these teeth when they do erupt to do so into a completely lingual position. Space in the permanent arch of good dimensions even in infinitesimal proportions is a precious asset; yet how often we find proximal fillings overcontoured, forcing adjacent teeth into an abnormal relationship. If this occurs before all of the permanent teeth have come into full eruption, it may cause one or more teeth to be deflected out of the line of the arch. The early loss of the first permanent molars not only presents a serious aspect from the resultant malocclusion thus produced, but also on account of the fact of stable anchorage being no longer possible, it becomes impossible for us to construct an efficient appliance, and treatment is either precluded or delayed. If there is delayed eruption of any of the permanent teeth after the loss of the deciduous predecessors, and it is shown by the roentgen-ray that it may be some time before the permanent tooth or teeth are to erupt, it becomes a dentist's positive duty to that patient either to construct a retainer for his case or to see to it that the child is seen by an orthodontist. If preventive dentistry is not a hackneyed and meaningless term, this is one of the finest opportunities to put it into practical application in our practice. There can scarcely be a dental practice of any consequence having children's work a part of the general program in which any number of these splints should not be employed. Make some of them in your practice. They are very simple to construct, and the parent is ordinarily willing to pay a fee commensurate with the service, if the necessity is properly brought to their attention. The construction of these splints opens a new field of thought in the dentistry we are performing for the children in our practice and proportionately increases our usefulness in the community. In the interest of the dental and physical welfare of our young patients, we must pursue a policy of careful inspection and the most careful dental service within our power, that we may save the child years of embarrassment, especially if they are not so fortunate as to be able to indulge in the services of an orthodontist. I should like to charge the orthodontist with his responsibility in disseminating the knowledge which he has gained in treating cases wherein preventable factors have in no small measure unwittingly contributed to his income. Orthodontia had passed many years as a specialty before we, as orthodontists, were able to correlate and classify preventable causes into a working

hypothesis. Yet we are prone many times to criticize the dentist for his apparent negligence or his lack of knowledge in a field of activity which may be of lesser significance in his practice. Perhaps, in the final analysis, a full consideration of our own responsibility in these matters may serve to alleviate many of the ills about which we complain.

Charles R. Baker, Evanston, Ill.: Frederick B. Noyes said, a few years ago, that he was sure 75 per cent of the cases of malocclusion which he had under treatment could have been prevented by the general practitioner.

ROOT CANAL TREATMENT PREPARATORY TO CROWN AND BRIDGE ATTACHMENT*

By JOHN J. MOFFITT, D.D.S., Harrisburg, Pa.

IN view of the fact that differences of opinion have arisen in our profession concerning the question of the relation of the pulpless tooth to the patient's welfare, we must do everything in our power to aid in solving this important problem. In considering the advisability of extracting all pulpless teeth or of retaining those with certain qualifications, it may give new light on the subject to view it from the standpoint of crown and bridge work. It has been authoritatively said that all pulpless teeth should be extracted, yet it is a serious thing to mutilate a young girl's mouth for life by extracting some of her anterior teeth because they are pulpless or because a loss of tissue outside the apex is revealed in the roentgenogram. It is also a serious affair to retain them if by so doing we cause, at some more remote period of life, arteriosclerosis, gallstones, arthritis, rheumatism or any of the long list offered for our selection.

If the teeth are extracted, it is certain that the prosthetist is going to have work to do; and the more teeth extracted, the more extensive that work will be. If as many as possible are saved, our friends the physicians and surgeons may sometimes be the beneficiaries, though with much less certainty. Where does the patient come in?

We all take chances in this life. We go on the sea in ships; we hasten from city to city in trains, we encounter thunderstorms and earthquakes, and we are whisked hither and thither in automobiles and aeroplanes. Some patients, although aware of the dire disasters ascribed to pulpless teeth, prefer to save as many of them as possible, for on the teeth depend appearance, vocal resonance, insalivation of food, physical comfort and length of life.[1] These patients who appreciate the value of their teeth are the patients that the conservative prosthetist must serve. By a conservative prosthetist, we mean one who endeavors first to restore to health and make permanently useful for attachments teeth which have had infected canals, instead of removing them and cutting into and jeopardizing vital teeth,

*Read before the Section on Operative Dentistry, Materia Medica and Therapeutics, at the Sixty-Ninth Annual Session of the American Dental Association, Detroit, Mich., Oct. 27, 1927.

1. Moffitt, J. J.: Dent. Cosmos, 55: 280 (March) 1913.

and who will endeavor to treat and crown a pulpless root rather than extract it to make room for a bridge.

A young girl was warned by several reputable dentists that she must have an upper central incisor removed because it imperiled her health. She insisted on having it treated and retained in place. This was attempted. She knows that she is risking physical disability twenty or thirty years hence, but her social activities require the presence of the tooth. She takes daily chances of the kind before enumerated and nightly chances of pneumonia with her dress and habits. (Figs. 1-3.)

Fig. 1.—Abscessed upper central incisor.

A man came into a dental office to have a filling replaced. He said that there was nothing else wrong with his teeth. When about to fill the tooth, the operator noted the local physical conditions, and took a roentgenogram. (Fig. 4.) The patient looked well and he said that he had never been ill in his life. Also, he said that the fillings had been inserted about twenty years previously and he wished the teeth saved if possible.

A middle-aged woman of good appearance whose lower teeth had been extracted to benefit a run down condition became almost a nervous wreck because her artificial lower teeth moved about. One or two of her teeth had been abscessed and several were broken down but all were firm. She said that she would have taken any chance there might be involved in retaining a few of these teeth for a stable attachment, but was told that they must be removed. She feels that her appearance, her social relations—her chiefest remaining interest in life—are ruined.

There are thousands and thousands of such cases, especially in young girls, who are in an agony of distress, because they were for one reason or another impelled to have invaluable teeth removed: a certain disaster against a speculative menace. (Figs. 5-7.)

Fig. 2.—Tooth shown in Figure 1, with root filled, apex amputated and abscess tract curetted.

The crown and bridge worker's policy as differentiated from that of the root canal filling enthusiast and the 100 per cent extractor is to present to the patient the case as it actually stands today: the serious results of the loss of teeth; the slight chance of a comfortable and hygienic restoration on teeth with vital pulps; the chance of systemic disturbance in future to be encountered from secondary infection, and the comfort of a properly constructed bridge, and then to share the responsibility with the owner of the teeth. As Dr. Buckley

has said, "Why not leave some of the responsibility with the patients without frightening them beyond all reason?"[2]

More than one systemic infection has occurred from a small splinter in a finger. In many cases, a splinter has even produced death from septicemia; yet who would think of cutting off a child's finger because it contained a suppurated area about a splinter? These things depend not only on the kinds of organisms encountered but also on the patient's susceptibility to that demonstrated organism. Without this bacteriologic knowledge, no one has any more right to induce patients to lose teeth that they value than the crown and bridge worker has to construct his appliances on pulpless teeth.

Fig. 3.—Tooth shown in Figures 1 and 2 one year later.

The conservative crown and bridge prosthetist, examining an applicant for restoration and seeing vital teeth at each end of the vacant space, views it with dismay, especially if the teeth to be restored are anteriors. If there were two or only one pulpless tooth whose history and physical and roentgenographic appearance were favorable, he could proceed at once. Why not, then, remove the pulps of the teeth necessary for abutments?

What Dr. Hunter has said has made us all more cautious, although it has been authoritatively stated that his remarks were not elicited by the work of the better class of American dentists. Price and Haden, Rosenow and others have spared no pains to show the calamities probably to be caused by the presence of pulpless teeth; but Buckley, Rhein and many others are continuing to fill teeth, with the evident intention of preserving their function.

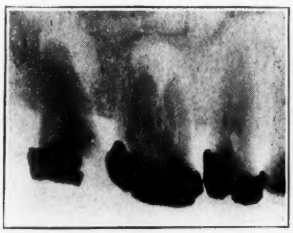

Fig. 4.—Unsuspected areas of twenty years' standing in the maxillary area of a healthy man.

Dr. Haden has said "A very high percentage of teeth that are negative roentgenographically harbor infection."[3] He evidently thinks roentgenograms are not to be depended on, but the crown and bridge worker reasons that when no evidence of infection shows in the roentgenogram, there is an escape of pressure that is somewhere physically manifest.

Joseph L. Miller[4] has said that it is fruitless to discuss the pulpless tooth unless we are first able to present defi-

2. Buckley-Price Debate, J. A. D. A., 12: 1522 (Dec.) 1925.

3. Haden, R. L.: Pulpless Tooth from a Bacteriologic and Experimental Standpoint, J. A. D. A., 12: 930 (Aug.) 1925.

4. Miller, J. L.: Problem of the Pulpless Tooth as Seen by the Physician, J. A. D. A., 13: 540 (May) 1926.

nite evidence that focal infections in general are a menace to the health. Hartzell, Black and many other authorities are of the opinion that this has not yet been done. Dr. Johnson[5] says, "Much of the propaganda against pulpless teeth has been worked up on insufficient evidence." The crown and bridge prosthetist feels that such men as these do not express their opinions lightly.

Peeso[6] has said definitely that it is permissible to devitalize teeth for the purpose of making bridge attachments

Fig. 5.—Extensive area in central incisor of young woman that would condemn tooth to extraction in many opinions.

if the operator is competent to do it as it should be done. Furthermore, the crown and bridge prosthetist knows, from his own experience and from the writings of many of our more conservative and illustrious dentists, that there are countless crowns and bridges, scientifically constructed on properly filled pulpless teeth, doing efficient service. He knows that thousands and tens of thousands of teeth have been mistakenly extracted in the past ten years, because these patients finally turn to him in their distress and he cannot but feel that an incalculable amount of harm has been done.

The conservative crown and bridge prosthetist cannot follow all the ramifications of Price's experiments and charts, but he knows that it is not a fair test to sterilize a tooth in an autoclave, encase its roots in plaster and then ask anyone to fill it, or to immerse a tooth so filled in an infected liquid for two weeks and then grow cultures from its tubules or cementum.[7] In the first place, the tooth could not be examined by roentgen-ray for guidance, and, in the second place, all the vital peripheral protective tissue is dried up, making absorption of the organisms inevitable. And he knows that if Dr. Price bases his condemnation of pulpless teeth on the ground that the cementum cannot be sterilized from within the tooth,[8] it signifies nothing since that is exactly what should *not* be done if the vital relation of the tooth to the surrounding tissues is to be maintained. As soon as the infection within reaches the circulation of the vital pericemental tissue, it

Fig. 6.—Tooth shown in Figure 5 properly filled.

5. Johnson, C. N.: Problem of the Pulpless Tooth as Seen by the General Practitioner, J. A. D. A., 13: 549 (May) 1926.

6. Peeso, F. A.: Conservation of Pulpless Teeth, Dent. Cosmos, 66: 674 (June) 1924.

7. Footnote 2, p. 1476.

8. Footnote 2, p. 1495.

is checked by action of the phagocytes, or antibodies, if the individual is immune to that organism. If he is not, the same organisms can enter his system through the nasal membranes, nasopharynx, tonsils, pyorrhea pockets, the appendix or any other source. Therefore, condemning and extracting such a tooth would be futile. Along the same line of reasoning, Rosenow[9] stated at the International Dental Congress in Philadelphia that practically all pulpless teeth including those negative in the roentgenogram are infected. This

Fig. 7.—Tooth shown in Figures 5 and 6, six years later.

is true beyond doubt, but are these infections sufficiently harmful to justify extracting the teeth? We find living pathologic organisms also in vital teeth. Our fingernails are similarly infected, but as soon as the infection reaches the vascular tissues beneath, it is checked. This is likewise true of the infected ends of filled roots. The organisms are held dormant or in attenuated form between the vascular blood supply of the surrounding tissues and the antiseptic root canal filling. This is another reason why there is often no roentgenographic evidence of infection. But of course these organisms will grow and rapidly proliferate when transplanted to the favorable conditions of artificial mediums and incubation. This difference in environment is so obvious that no definite deductions can be drawn from the findings.

Our research work is necessary even concerning things we do not need to know. It is scientific, exacting, commendable, but should be clinically proved before it be permitted to affect the practical application of dentistry.

Viewing the evidence at hand, the conservative crown and bridge prosthetist feels that he can safely proceed,

Fig. 8.—Improperly opened tooth. Enamel touching the instrument hinders the tactile sense in following the root canal.

crowning pulpless roots and using them for abutments for more extensive operations when the history, physical conditions and roentgenographic evidence are satisfactory.

We now come to the description of a simple and effective method of preparing root canals for the permanent support of crowns and bridges, recommending, and insisting, that, when possible, the bridges be removable ones.[10]

PREPARATION OF ROOT CANAL

There are numerous classifications for determining methods of treating and

9. Rosenow, E. C.: Oral Sepsis in Its Relationship to Focal Infection and Elective Localization, J. A. D. A., 14: 1436 (Aug.) 1927.

10. Moffitt, J. J.: New Methods in Removable Bridgework, J. A. D. A., 12: 1042 (Sept.) 1925.

filling root canals,[11] but when it comes to actual practice, two will suffice: roots with small apical foramina and roots with open foramina. This method is dependent on these propositions: the securing of an encapsulation of the apex with vital tissue (open apices) or restoration of the continuity of the pericementum (closed apices); the preservation of drainage during treatment, and the obvious fact that the crown of a tooth is of no value if its apical area is actively infected.

Therefore, access to each root canal

Fig. 9.—Properly opened tooth. All impressions received are from the point of the instrument.

should be gained at the expense of the structure of the crowns. Every canal to be treated should be enlarged as far as the strength of the root permits. This removes the cancellated interior of the root, reducing the chance of future infection, gives freer access to the apex and aids the operator's tactile sense. (Figs. 8-9.) The dentinal tubules opening from the pulp are five times as large as at the periphery and the supporting strength of a root is the layer just beneath the cementum. (Fig. 10.)

In some cases there should be a preliminary roentgenogram to determine the number and direction of the roots but this is not necessary in most cases.

11. Moffitt, J. J.: Dent. Cosmos, 55: 282 (March) 1913.

As soon as the root is sufficiently enlarged, a hard guttapercha root canal filling, shaped to conform to the enlarged canal, is temporarily inserted, and the tooth is roentgenographed. Assistants soon become proficient in rolling these points from warm base plate guttapercha, having the fingers wet with liquor antisepticus. When the roentgenogram is completed, the guttapercha filling is removed from the root and is compared with its projection on the roentgenogram. From this comparison, the exact length of the root can be deter-

Fig. 10.—Diagram showing enlarged tubules opening from pulp that should be cut away before filling.

mined and also the most advantageous position for the guttapercha root canal filling when it is permanently inserted. (Figs. 11-12.) Long handled instruments should be used for increasing tactile sense, and for ease in sterilizing and facility in following curves, this lessening the danger of puncture.

The use of the rubber dam is not necessary and is often dangerous as the tissues that it is forced into cannot be sterilized. During an operation, there are but two ways the root canal can be additionally infected: by the instruments and an influx of saliva. Neither the use of the rubber dam nor previous

boiling will guard against mishandled instruments and the presence of any nonvolatile germicide in the canal will prevent infection from saliva. Even this, while safer, is not absolutely necessary as we cannot protect the apical end with either germicide or dam when amputating an apex. The root canal should be wiped with creosote, formocresol, phenol or any nonvolatile germicide that is permanent, without excess, on a very small cotton pellet, no larger than the canal diameter, and each instrument point should be touched in the same

Fig. 11.—Proper enlargement of root canal for base-plate guttapercha cone, temporarily inserted to determine the length of the root and the most advantageous position for permanent insertion.

germicide before it enters the root canal. We keep 1 drop on a tray so that only the point touches it. If a pause in the operation be required, the root canal opening should be closed with a pellet of cotton containing liquor antisepticus, or any antiseptic solution for use in the mouth, to protect the tissues from being burned by the germicide. If this procedure is adhered to, no infection can occur in the root canal and elaborate rubber dam and instrument sterilizing preparations are unnecessary, which greatly simplifies the operation.

In removing a pulp of a vital tooth for the purpose of supporting a bridge, the operator assumes a certain amount of responsibility, which is no greater than the responsibility assumed by one who extracts a tooth solely because it is devitalized, and probably not nearly so great. (Figs. 13-14.)

The finer the artificial structure and the more work he puts on it, the more careful the crown and bridge worker is going to be about the roots to which he attaches them. And although he can accept the favorable diagnosis of the con-

Fig. 12.—Proper placing of guttapercha cone.

dition of a tooth that has already been filled, when he assumes the responsibility of devitalizing a tooth, he will wish to follow the method of procedure that is sure to give him the desired result.

We know that a tooth showing a pathologic condition at the apex has an opening from the interior of the tooth into the diseased tract, and from this opening the infection has issued. A vital tooth, or one properly filled, or an uninfected devitalized tooth, has a pericemental membrane which is continuous over the apex. This means that the rational method for treating root canals is to proceed with the object of having the apical foramen closed up, since it is no longer useful as an entrance for the vascular supply to the pulp, by healthy natural tissue, that is, encapsulated.

This furnishes a goal for the operator, and it makes no difference by what medicament or by what method of filling it is attained, if the desired result is accomplished.

It is not very difficult to visualize those conditions that will interfere with having the apical foramen encapsulated with healthy natural tissue. There are five principal ones: infection; projection of instruments through the apex; compressing air in the root canal under temporary fillings; the presence of escharotic drugs where the new membrane of encapsulation is to be formed, and excess of heat. The method of removing a vital pulp that we employ is as follows: The pulp is removed by cocain, pressure, nitrous oxid, procain or whatever is suitable to the conditions of the patient or the usage of the operator. The pulp is not infected and it must not become so. This is prevented by the use of a suitable germicide on all broaches and drills. This germicide is not allowed to penetrate the apical foramen but is used to prevent infection entering from without. As soon as the pulp is removed, the obstructing dentin is cut away and the canal enlarged. The guttapercha cone, made to conform with the size of the canal, is inserted without pressure and the roentgenogram made. This will disclose any irregularities and determine the length of root and the proper position for the guttapercha. It is usually the only roentgenogram necessary.

Fig. 13.—Tooth of young girl in which the pulp was destroyed by trauma. It was removed at once and the tubules were bleached and protected by thin white chloropercha, which has prevented discoloration for four years.

Teeth that have small apices, when there is no bleeding, can be filled immediately on removal of the pulp, if haste is necessary. In these teeth, the apical opening is so small that if nothing has been done by the operator to prevent it, the pericementum will close over the foramen. That is, if no instruments have protruded, if no infection is carried through, if no pressure has occurred, if no escharotic drugs have been forced through or if too much heat has not been applied, reconstruction will begin at once.

Fig. 14.—Root of first permanent molar filled over thirty years ago. The fillings do not reach the apex, which is naturally encapsulated. The surrounding tissue is normal.

If the apical opening is large or has been enlarged, blood or serum drain into the canal, and considerable care must be taken to have the encapsulating membrane well established before filling. After the root canal is cleaned, the roentgenogram made and the length of the root determined as before described, a dressing is inserted with liquor

antisepticus. This must not be tightly packed and must be so inserted that there will be no pressure on the apical tissue where the membrane is to be formed. All dressings, especially if the cotton is shaped in the fingers, when of only antiseptic strength, must be held in the flame before being used. When the dressing is completed and a temporary guttapercha filling to close the opening is inserted, drainage must be preserved. A small piece of wire should be put in the root canal so that it will project above the guttapercha. This is

Fig. 15.—Simplest form of drainage filling. Wire is placed in the metal disk with a hole in the center. After the dressings are inserted in the root canals, the disk (with wire) is placed in the pulp chamber. When the hard guttapercha filling is finished and chilled, the wire is withdrawn, this preventing pressure in root canals and establishing drainage.

withdrawn after the temporary filling is inserted, in order to release the compression of air which almost always occurs when guttapercha is packed into the opening of a root. This same drainage should be used in teeth with small apices if soreness prevents immediate filling. (Fig. 15.)

When, after several days, the dressing shows no discoloration from seepage, a slight membrane has formed over the apex. The method of filling then employed should be one that will not damage this membrane over large foramina. It should be one that could be used in case of small foramina where healing is by first intention, and it should be one that will promote encapsulation in denuded or amputated apices.

FILLING THE ROOT CANAL

Filling the root canal after these preparatory proceedings is a simple matter, consisting in replacing the guttapercha cone used in the preparation of the canal and seating it in an antiseptic (or preferably germicidal) paste.[12] The root canal instruments are marked, the length of the root being indicated by the use of sticky wax or by some other suitable method. The guttapercha cone

Fig. 16.—Trial filling of hard guttapercha.

which fits the prepared canal is soaked in creosote so that its substance is filled with this permanent germicide. The root canal is lined with the antiseptic paste. Marked instruments are employed, never being inserted beyond the marks no matter how great the temptation is to push on till the patient feels it. Into this, the cold, hard guttapercha cone is inserted in such a way that the excess paste comes out around it and the guttapercha takes the place to which it had been molded. (Figs. 16-17.) Inserting the guttapercha filling cold prevents pressure in the apical

12. Author's formula: iodoform, 1 part, bismuth subnitrate, 5 parts, zinc oxid paste, 10 parts, made into a paste with creosote (without excess).

area. The outer end after the excess paste is removed is wiped with chloroform and sealed to the root canal wall with a hot instrument. It is not necessary for the guttapercha filling to reach the apex in case of small foramina, and it is sometimes best not to attempt it as the antiseptic paste inserted by the marked instruments is sufficient. Roentgenograms mean nothing in determining whether the root is properly filled. They would have to be magnified 1,200 diameters or more to reveal whether or not micro-organisms were excluded or the canal was sealed against them. If the pericementum is shown joined over the apex, that is all that can be desired.

Fig. 17.—Tooth shown in Figure 16, with canal properly filled.

In cases in which the apical foramen is open, the guttapercha root canal filling should approximate the apex. The guttapercha filling previously fitted to the root is used cold when the opening is quite large. Its apical end is touched in melted paraffin and it is quickly pressed into the root canal. This fits the paraffin to the apical opening. It is then removed and inserted permanently with the antiseptic paste as before described. Paraffin is similarly employed in cases of root amputation as its use helps to induce encapsulation. (Figs. 18-20.)

In chronic cases in which long treatment is required, a metallic filling of gold, acolite or aluminum can be made having drainage holes in it which need little attention until the area is no longer evident and the pericementum is reestablished. (Figs. 21-23.) When treatment does not produce the desired effect, the apical area should be curetted with a No. 7 or 9 round bur and packed with a little iodoform gauze, which is diminished in size until no longer needed. If this proves ineffiective, amputation of the apex is indicated. If amputation of the apex does not effect a cure, extraction is inevitable, unless an autogenous vaccine can be administered.

Fig. 18.—Enlarged apex filled with paraffin above guttapercha to promote healing; results after three years. There had been a serious abscess.

Autogenous vaccines are very effective when systemic involvement occurs in connection with chronic abscesses or pyorrhea. They should not be confounded with stock vaccine, the results of the use of which are uncertain. The employment of properly administered autogenous vaccines made from the specific organism preying on the individual is decidedly beneficial and, in many cases, has cured both local and systemic conditions without the loss of the affected teeth.

It is now well known that the natural encapsulation of the root apex of pulp-

less teeth is the object to be attained in the conservative treatment of infected and otherwise pulpless teeth. It obviates the necessity of extracting these teeth

Fig. 19.—Apex of upper lateral incisor amputated.

and thus imperiling the efficiency of those remaining. Years ago, Dr. Rhein attempted to establish mechanical encapsulation of the root by forcing the filling material through the apex. This was, no doubt, successful in some cases but it did not appeal to the majority of dentists as

Fig. 20.—Area shown in Figure 19, several years later. There is complete filling in of bone and restoration of pericementum; or natural encapsulation.

efficacious. Encapsulation of the apex of the root was long ago recognized as a connective tissue restoration. It may be considered a process of encapsulation similar to that of Nature's treatment of foreign bodies, such as an embedded bullet or a silver wire ligature. The end of the root (the apical foramen having lost its natural function) and the denuded root adjacent to it may thus be considered a foreign body, and this natural process is the one that insures the

Fig. 21.—Drainage filling, gold or acolite. The opening straight down through the filling is for clearing obstructions and is closed at the top with cement or guttapercha to prevent food entering. The right angle hole is kept open for drainage. Mild antiseptic dressings are used in the root canals. A small piece of cotton in the pulp chamber contains creosote or some other germicide to prevent infection entering.

permanent usefulness of the pulpless tooth. Dr. Crane[13] recognized this truth in quoting Dr. Grieves: "Some process

Fig. 22.—Bone absorption due to infection in upper first bicuspid.

other than the dentist's processes is the final equation in root canal treatment. . . . The factor which fills the apical opening is the complicated reparative processes common to all body connective tissue." An early mention of the natural encapsulation of pulpless roots was made

13. Crane, A. B.: Dent. Cosmos, 68: 710 (July) 1926.

in the discussion of a paper by Dr. Buckley at the annual meeting of the Pennsylvania State Dental Society in 1911.[14]

CONCLUSION

A great many molar teeth are being extracted because on one of the roots there is an abscess. If a tooth of this kind is cut in two, and the half with the abscess removed, the other half gives just as good an attachment for a bridge as any single rooted anterior tooth. This will save much distress to the patient if

Fig. 23.—Case shown in Figure 22. The arrow shows where the area of absorption had been; result of nine months' drainage without touching the drainage filling. The root canals were then filled and have remained in the same condition for eight years.

the tooth is the last remaining molar, for the absence of attachment at the posterior end of the arch has been one of the greatest problems in prosthetic dentistry. I wish to repeat that it is not necessary to use rubber dam in operations. Avoid using too much heat, as these cases must be treated precisely as any other wound when healing is desired, and when moisture is necessary to reconstructive growth. Do not use pressure anesthesia on a pulp that is infected, as the infection may be forced through the apex.

Rosenow and Price and other students of the pathology of pulpless teeth have made us realize our responsibility in attempting to retain these teeth without harm to the patient. Many of the illustrations used by these writers have disclosed inadequate dentistry, which made impossible the natural restoration process of encapsulation to which the patient is entitled. It is quite likely that comprehensive study and development utilizing these natural restorative processes would go far to solve this great problem of the future of the pulpless tooth. We owe it to the public to view it without prejudice, and to ourselves to consider it studiously as a means for the advancement of our profession.

DISCUSSION

Arthur H. Merritt, New York City: Judging from my own experience, Dr. Moffitt's paper is at once too conservative and too radical: too conservative in its attitude toward infected pulpless teeth; too radical in advocating the removal of pulps from healthy teeth in the construction of bridge restorations. In their treatment, some infected, pulpless teeth will always have to be extracted, while some can be saved by treatment. Each case will have to be considered by itself. There are few cases which justify pulp removal in any restorative operation. Wherever it is possible to apply it, I believe it to be desirable that the rubber dam be employed in the treatment of pulpless teeth. Autogenous vaccines, in my experience and from my observation, have not been anything like so valuable in the treatment of focal infections as indicated by Dr. Moffitt. Generally speaking, their use under these conditions has been disappointing.

Paul C. Kitchin, Columbus, Ohio: Dr. Moffitt's views on the root canal treatment of teeth to be used as bridge abutments merit our earnest consideration. It is my belief that the conservative attitude toward the pulpless tooth is the one which must ultimately prevail. A few questions and minor disagreements occur to me. He asks, "Why not remove the pulps of teeth necessary for abutments?" Granting that these might be anterior teeth and that in a pulpless condition they might make stronger abutments than with the pulps intact, is it wise to volun-

14. Dent. Cosmos, 53: 1417 (Dec.) 1911.

tarily bring a possibly doubtful link into the chain of restorative procedures? Would it not be the more conservative thing to utilize two anterior teeth for the abutment, attaching by three-quarter crowns or some other means not involving extirpation of the pulp? Nor should we fail to consider the partial denture, when accompanying conditions warrant this type of restoration. In other words, should not the crown and bridge practitioner exhaust every method in attempting to restore lost parts and, at the same time, preserve the pulps of those remaining even though it takes his patient into the partial denture field? Surely, we can find cases enough demanding extirpation of the pulp without creating the condition. Fixing our attention now on the quotation regarding Dr. Haden's findings,[3] we note that while indicating his stand on diagnosis based solely on the roentgen-ray, if we follow him just a little farther, we get a clearer light on his attitude toward the problem in question. He continues the statement given you by Dr. Moffitt thus: "A fairly large percentage (70 per cent of 425 teeth cultured) of teeth that are positive roentgenographically, did not harbor any infection or sufficient infection to be a factor in systemic disease at the time the culture was taken. In such cases, the infection has probably run its course and become bacteria free, as happens in infections elsewhere in the body." The last part of the foregoing is especially to be noted because it classifies the apical infections of the teeth with infected areas in other parts of the body which can and do respond favorably to surgical aid. It also classifies Dr. Haden as an unprejudiced investigator of the problem in that he concedes what is apparent to students of histology, that there is nothing unique about the apical dental tissues which would render surgery in their vicinity null and void, or worse. Dr. Moffitt's reference to Dr. Price's work[7] regarding the imperviousness of cementum makes it pertinent that we also recall the more recent findings of U. G. Rickert[15] wherein the apical cementum was shown to be pervious under experimental conditions. But the important thing is that whether impervious or pervious makes little or no difference in treating root canals. If, as C. N. Johnson points out,[16] cementum is impervious, it seals out infection as well as holding it in. If pervious, the action of penetrating nonescharotic antiseptics may accomplish much in reducing the virulence of the infecting organisms in the dentin, cementum and peridental membrane and, with the aid of the vital processes in the pericementum itself, eventually render the area bacteria free, as suggested by Dr. Haden. The treatment of root canals as outlined by Dr. Moffitt is doubtless very effective in his hands. Adherence to the use of liquor antisepticus which Dr. Prinz characterizes as a toilet preparation and useless as an antiseptic, and which was dropped from the Pharmacopeia in 1916, and advice against the use of the rubber dam in root canal operations, come as distinct shocks, but merely accentuate what may be accomplished in skilled hands in spite of the methods used and not with the aid of them. To date, this root canal problem defies systematization. It confirms Kipling in his statement that "There are a thousand ways of doing a thing and every one of them is right." Starting with a measure of vitality and resistance in the pericemental membrane and avoiding procedures which reduce these essential factors, the removal of the larger share of the infective organisms and the exclusion of additional ones will bring desirable results. It is probable that future investigations based on careful root canal operations, that is, those carried out in the light of what we now know about the tissues involved, will give results more favorable to this phase of dentistry than ever have been given to date. In this regard, it is interesting to note that Dr. Kirk[17] says "As we view the situation, the one greatest hope of the return to leadership of operative dentistry lies in the development of the esthetic phase of dental practice. And this will be solely and inevitably subsequent to the perfection of a safe and sane root canal procedure and to the successful development of a means of permanent dental restoration through porcelain or some such material that will adequately meet the growing demand upon dentistry from the esthetic standpoint." It doubtless

15. Rickert, U. G.: Fundamentals of Successful Root Canal Treatment, J. A. D. A., 14: 1661 (Sept.) 1927.

16. The Buckley-Price Debate, editorial, J. A. D. A., 12: 1541 (Dec.) 1925.

17. The Decline of Operative Dentistry, editorial, Dent. Cosmos, 69: 1067 (Oct.) 1927.

would aid us all in evaluating suggested methods of treating root canals if we could have the opportunity of knowing, from the study of carefully gathered data, just what happens in at least forty cases of root canals filled according to the methods under discussion. Personally, I would appreciate follow-up details on Dr. Moffitt's method to enable me to determine for myself just how closely he is carrying us toward the "safe and sane" procedures we all covet.

Dr. Moffitt (closing): The best answer I could give to the discussers would be to show the remainder of the pictures. Figure 13 shows a root properly filled. It could be used if necessary as a permanent abutment and would last; so why not remove the pulp of such a tooth rather than have a damaging attachment on a vital one? Dr. Merritt speaks of the necessity of using the rubber dam in root canal treatment. We never use it. Dentists extract teeth all over the country, and there is rarely any trouble in the unprotected sockets of those teeth. I do not see why, then, when you are going to treat canals, and since we often find roots below the level of the gums on which you cannot put a rubber dam, that it would be wrong to treat such roots because you cannot use the dam. What Dr. Merritt has said about pulp removal is true in all cases when you do not know the latest methods of treating pulps properly. We take them out, when necessary for abutments, and have no trouble, and thus protect the adjoining tooth from recession of the gums and from dentures that have clasps, by the use of inside attachments.[18] In anterior teeth, especially, it is necessary to know how to remove the pulp and keep the tooth in place. We know that we can keep devitalized teeth in the mouth for forty or fifty years. It is the ones not handled properly that afterwards give trouble. In anterior teeth especially, bridges should be anatomically correct and show no clasps or other attachments. These are much more satisfying to the patient, even to men. If you feel that you cannot treat them that way, there is some flaw in your work; just as in working without a rubber dam: if you cannot do it successfully, you should not use the method. I agree with what Dr. Kitchin has said about Dr. Haden. He is very conservative. I merely quoted from him to illustrate the point. Dr. Merritt has spoken about autogenous vaccines not being very efficacious. We have been using autogenous vaccines for about fifteen years and we have found in most cases that they are very beneficial to the patient. They never do any harm. Many times they strengthen the patient systemically, and the operator feels that he is protecting the patient while working on infected teeth and that there is no danger that a systemic infection will develop.

18. Footnote 10, p. 1043.

PTYALIN-BLOOD BROTH: A NEW MEDIUM FOR THE CULTIVATION OF MOUTH ORGANISMS*

By GEORGE FENN ROBERTS, M.D., Buffalo, New York

IN presenting this formula for a nutritive medium, I have only filled the want (if we except Loeffler's blood serum) of something in which oral organisms will grow freely.

My idea was to make (approximately) a fluid that would represent the saliva as found in an ordinary mouth, as many organisms which can be found in mouth smears refuse to grow on the commonly used mediums.

The first step was taken by using a 0.5 per cent boiled starch solution, human saliva being employed as a source of

*Read before the Section on Histology, Pathology, Physiology, Bacteriology and Chemistry (Research) at the Sixty-Ninth Annual Session of the American Dental Association, Detroit, Michigan, Oct. 26, 1927.

ptyalin, but it was difficult at all times to obtain a suitable saliva, so I asked Messrs. G. W. Carnrick of New York to prepare for me an active dessicated powder of the three different salivary glands.

In looking around for a better substance than starch, I was led by a brewer friend of mine to try flaked corn, manufactured by the Buffalo Cereal Co. This corn is used along with malt in the making of near beer, etc.

This proved to be a great improvement as you will see from the quoted analysis that it contains vegetable proteins as well as starchy matter.

The material required for the new medium is given in Table 1. The analysis of flaked maize is given in Table 2.

1. Average composition from practical points for practical brewers published by the National Brewers Academy, New York.

TABLE I.—MATERIAL REQUIRED FOR THE CULTIVATION OF MOUTH ORGANISMS IN PTYALIN-BLOOD BROTH

	c. c.	Source
Flaked Corn (maize)	10.00	Buffalo Cereal Co.
Distilled water	1,000.00	
Dessicated parotid gland.	1.00	Messrs. G. W. Carnrick, 15 Laight St., New York City
Dessicated submaxillary gland	1.00	
Dessicated sublingual gland	0.50	
English drop chalk ($CaCo_3$)	10.00	
Defibrinated sheep's blood.	100.00	

The directions for making are as follows:

Soak the flaked corn in the distilled water overnight. In the morning, boil until the corn is well cooked, then pass through a tomato sieve, allow it to cool and add the glands and the chalk, using a glass pestle and mortar to mix them. Place in an incubator and shake from time to time. Next morning, test with iodin. There should be no violet coloration.

Then add the defibrinated blood and about 5.0 c.c. of toluene. Place in the incubator again for forty-eight hours. Boil this mixture for about twenty minutes and strain through cheese cloth and absorbent cotton, pouring enough distilled water over the strainer to keep 1 liter. Measure out 10.00 c.c. and drop in lime water to make the p_H 7.5. Then add enough lime water to bring the whole amount to this reaction using brom-thymol blue as the indicator. Sterilize. The mixture should be perfectly clear and of a light straw color.

TABLE 2.—ANALYSIS OF MEDIUM

Water	10.160
Soluble protein	0.152
Insoluble protein	10.370
Fat	0.570
Fiber	0.610
Ash	0.460
Carbohydrates (starch)	77.830
Equivalent in maltose (calculated)	86.500
Cold-water soluble substances	27.520
Reaction of solution to litmus, neutral.	
Reaction of solution to phenol phthalein, colorless.	
Reaction of solution to methyl-orange, neutral.	
Reaction of solution to Fehling's solution, strong reduction.	
Reaction of solution to alcohol, heavy precipitate.	
Reaction of solution to iodin, dark blue.	

TECHNIC

The cereal is soaked overnight, as it makes a better mixture and does away with long boiling. Passing through the sieve also breaks up all the flakes. English drop chalk ($CaCO_3$) was found to act better than the precipitatus carbonate as the former is amorphous and the latter crystalline. If this chalk is not

added, the mixture becomes unduly acid and the ptyalin ceases to work.

The toluene is only used to prevent putrefaction and is lost in sterilization. The neutralization is made with lime water as it has been found that sodium salts such as the chlorid are not beneficial to the growth of many organisms. The finished fluid is sterilized by the fractional method in an Arnold sterilizer.

The solidification of this medium by the addition of agar-agar is not a success as regards aural organisms, as many that grow well in the fluid refuse to grow on the solid medium. This appears to be purely physical, as, when nutrient agar is placed in the incubator, it slowly dries up, the surface, of course, first, and the lack of moisture there is probably the cause of the nongrowth. If agar is used, it should be washed three times with distilled water before being placed in the ptyalin-blood broth.

So far, I have not tried out the addition of pieces of fresh sterile tissue such as the brain nor used fresh blood to enrich it.

Among the organisms that grow especially well are the streptococci, for the growth of which I have found it the best broth to use.

I have tested this medium out for the last two years, and the more I use it, the better I find it in our root-canal clinical work in the Dental Department of the University of Buffalo.

281 Emslie St.

SYSTEMIC CONDITIONS AS CAUSATIVE FACTORS IN MALOCCLUSION*

By SAMUEL J. LEWIS, D.D.S., Detroit, Mich.

WHAT is the truth about systemic conditions as causative factors in malocclusion of the teeth? The views most widely held today go back to our textbooks on orthodontics. We find that such diseases as scarlet fever, whooping cough, measles and chickenpox are believed to cause malocclusion because they are known to have a deleterious effect on the epithelial structures. We find syphilis mentioned as a possible cause since it produces a certain type of hypoplasia of the enamel, which, in turn, destroys the force of the inclined planes. We find rickets causing a specific type of malocclusion described as a general narrowing of the maxilla and a widening of the mandible in the region of the rami and the body, the lower portion of the mandible being turned outward and the teeth inward, the result of the muscular forces exerted on them. We find that tuberculosis gives a result almost directly opposite to that of rickets, in that the eruption of the deciduous and permanent teeth is early instead of late; also that the deciduous roots are not absorbed, and thus the permanent teeth are forced to erupt by the side of the deciduous teeth.

*Read before the Section on Orthodontia and Periodontia at the Sixty-Ninth Annual Session of the American Dental Association, Detroit, Mich., Oct., 27, 1927.

Scorbutus, marasmus and kindred diseases are mentioned occasionally as interfering with the process of dentition. We find acromegaly causing an overgrowth of the mandible. There is some mention of progeria, a rare disease in which, though the teeth are normal in size, the jaws remain infantile, as a direct cause of malocclusion. We find other endocrine disturbances, such as cretinism, mongolism and myxodema, causing malocclusion of various types. According to the textbooks, there seems to be no end to the number and kinds of systemic conditions that may cause malocclusion.

Angle[1] has crystallized the whole matter for us. In speaking of etiology, he says, "Most of the immediate causes are mechanical, yet whatever acts as a hindrance to Nature in performing her delicate offices in the unfolding of the various tissues composing the dental apparatus will be operative as a cause in producing malocclusion."

Although this statement was written more than twenty years ago, our present conception of systemic conditions as causative factors in malocclusion conforms quite closely to it. Perhaps it did not occur to Angle that disease entities should be studied separately in reference to their possible effect on the growth and development of the teeth and jaws, but he supplied the impetus which led other investigators to so study them.

Almost every orthodontist today believes that systemic conditions may act as causative factors in malocclusion. Just how they act is perhaps not yet clear, but this admission does not bind us to any set theory, nor does it mean that we have accepted the conclusions as set down in the various textbooks.

1. Angle, E. H.: Treatment of Malocclusion of the Teeth and Fractures of the Maxillae, Ed. 7, Philadelphia: S. S. White Dental Manufacturing Company; p. 89.

The mere publication of the conclusions of textbook authors, conclusions derived largely from personal observation or philosophic speculation, is no proof that they are correct, textbook authors being often not scientific. Only scientific observation on the infant, and a continuation of such observation during early and late childhood, will enable us to arrive at a logical conclusion as to how systemic conditions act as causative factors in producing malocclusion. We must gather reliable statistical evidence. And, too, we must experiment on the larger animals, such as monkeys, dogs and pigs, if we are to supply convincing evidence in the field of etiology. The authors of many textbooks have given us few or no real data upon which they base their conclusions.

If we are to approach the study of etiology in a thoroughly scientific manner, we must first clarify our conception of cause and factor. Too often, these terms are used synonymously by writers, much to the confusion of the reader. In one textbook, for example, the author says[2]: "The etiological factors that induce maldevelopment of the jaws and irregular positions of the teeth are divisible into two classes, constitutional and local. The constitutional causes will be distinguished as inherited and acquired." From then on, he discusses causes, rarely factors, and it is, indeed, difficult at times to extricate oneself from the maze of words. Now a cause, in a literal sense, is that which produces a result which would not exist without it. It is the sole determining effect of a condition. For example, *Bacillus diphtheriae* is the cause of diphtheria. A factor, on the other hand, is one of the elements, circumstances or influences that contribute to produce a result. For example,

2. Jackson, V. H.: Orthondontia, p. 13.

nutrition is a factor in the growth of the body. In the light of our present knowledge of etiology, we are concerned more properly with factors than with causes; for, as A. Leroy Johnson has well said,[3] "The forces which determine the development of any part of the living organism are so complex that we must, when referring to etiology, speak in terms of contributing factors, not of cause in the definite literal sense."

"But," some will object, "why haggle over words and phrases so long as we are succeeding from a practical standpoint and are able to get results?" It is a psychologic truth that most of us are reluctant to break away from tradition, and it is just this attitude that hinders the progress of any science. We like to be orthodox. We are satisfied to rest on our laurels and let the rest of the world go by. We like to look through rose-colored glasses. We want to know more about moving teeth: we are not interested in basic principles. But such an attitude does not make science: it does not supply the impetus which has led our small group of research workers to look for new empires to conquer: it does not help to uncover new truths.

Let us look for a moment at some of the accomplishments of the last fifteen years. What are some of the facts that have been uncovered by those few men who were bold enough to break the bonds of convention and literally to defy the very gods who control our destiny?

In 1914, Milo Hellman,[4] in an investigation of some etiologic factors in malocclusion, decided that the problem of etiology had been approached with a limited degree of scientific accuracy. He thought that if the causes of malocclusion must be studied from the basis of normal growth, our efforts should be directed toward a better understanding of the laws involved, not only in postnatal development, but also in antenatal physiology and antenatal pathology. He further reasoned that although a disease or a disturbance of any form represents the sum total of a symptom complex, it may appear in any of its intermediate stages of development, and that, in order to increase our knowledge in that direction, we have to acquire an absolute mastery of all the probable factors that enter into the composition of a symptom complex. "And," he concluded, "in order to acquire that knowledge, a uniform course of procedure must be adopted by which a cooperative common movement could be initiated for the collection of all such data as would help toward a solution of this problem." Such a movement not materializing, Hellman, undaunted, set about, in his modest scientific manner, to gather these data himself. In 1921, he[5] reported the results of his studies on the etiology of Angle's Class II malocclusal manifestations. For this study, he examined 354 children, both boys and girls, ranging in age from 3 to 15 years. Of this group, 71, or 19.94 per cent, were breast fed, 86, or 24.17 per cent, were bottle fed, and 199, or 55.89 per cent, were breast fed for a time (from a few days to about six weeks) and later had to resort to the bottle. Both the bottle fed and breast and bottle fed numbered 285, or approximately 80 per cent. Normal occlusion of the teeth among these children existed to the extent of 3 per cent, while 97 per cent had various forms of malocclusion. These

3. Disc. Hellman, Milo: Footnote 5; p. 97.

4. Hellman, Milo: Study of Some Etiological Factors of Malocclusion, Dent. Cosmos, 56:1017 (Sept.) 1914.

5. Hellman, Milo: Studies on the Etiology of Angle's Class II Malocclusal Manifestations, Proc. Am. Soc. Orthodontists, 1921.

children were examined also in reference to their disease history as correlated to malocclusal conditions. The accompanying table shows this distribution.

It will be noted that in the most frequently appearing disturbances, in accordance with the different classes of malocclusion, there is no indication of any particular grouping. This is a significant fact. To quote Hellman[4]: "For example, mouth breathing and its cause, adenoid vegetation, which is generally blamed for Class II manifestations, is equally divided between Class II and other classes. The only instance in which there seems to be a positive correlation is sucking habits and Class II Division I cases."[1]

Time does not permit going into the details of Hellman's study, nor is it necessary for our discussion. Suffice it to say that in most instances few, if any, of the systemic factors recommended by the textbooks were found to bear any definite relationship to any particular form of malocclusion. Hellman did not find any correlation between disease processes and any definite form of malocclusion. For more detailed information, it is suggested that this article, which is published in the proceedings of the American Society of Orthodontists for 1921, be read carefully.

Prior to the appearance of Hellman's work, H. K. Hatfield,[6] of Boston, made an investigation at the Massachusetts School for Crippled Children, in an effort to arrive at a possible correlation between rickets and malocclusion. It will be remembered that in certain textbooks we found a specific type of malocclusion attributed to this disease. Hatfield selected fifteen children in whom there was a clear diagnosis of the disease; and besides going into their medical history, he made models of their teeth and dental arches. Contrary to the generally accepted theory, he found no definite type of malocclusion. Moreover, in some cases, the arches were well formed and approached the normal. He reasoned that, while softening of the bone is characteristic of rickets, the form which the bone takes on as a result of the disease is not typical of the disease but rather expresses the mechanical force acting on the bone. He also says that the mandible is a plastic structure in health which, under the stress of mastication, preserves its form; hence, in softening of the bone, and with uniform muscular weakness, no change in the bone necessarily occurs.

J. Sim Wallace[7] makes a similar discovery. He limited his examination to people who had bow legs, an indubitable sign of rickets in children; and in approximately one hundred cases examined, there was no evidence that those who suffered from rickets presented any greater indication of malocclusion than other people.

On the other hand, both investigators agree that the introduction of an artificial force, such as thumb sucking or pacifier sucking, or a change in muscular action, might alter the equilibrium determined by function and produce a deformity.

There is yet much to be done in the investigation of rickets; and new knowledge, we hope, will soon be forthcoming in an investigation of animal research now being conducted by E. V. McCollum, at the Bureau of Animal Industry Farms, Bellsville, Md., under the auspices of the American Dental Association

6. Hatfield, H. K.: Preliminary Study of the Effects of Rickets on the Jaws, Proc. Am. Soc. Orthodontists, 1919.

7. Wallace, J. Sim: Variations of the Jaws, St. Louis: E. V. Mosby Co., 1926.

research commission. In a recent conversation with Dr. McCollum, I learned that rickets was no longer considered as a disease of the bone, but that it affected every tissue of the body, and that, in our future studies, this must be taken strictly into account.

Dr. McCollum is feeding seventy-five sows on deficient diets while they are nursing their young. When the second generation sows are old enough, he will feed them on deficient diets while they in turn are nursing their young, and so on for several generations. His plan is to cause various bone disturbances to see what effect they will have on the teeth and jaws. He chose pigs because they are large animals and have their permanent dentition by the eleventh month. What Dr. McCollum will discover, no one knows; but we can rest assured that he will give us the results without bias, and they will be supported by scientific evidence.

Along a somewhat different line of investigation, C. C. Howard,[8] of Atlanta, Ga., attacked the problem of endocrine disturbances in an effort to correlate them with certain malocclusal manifestations. He concluded that individuals with malocclusion should be studied from a general standpoint, with the help of medical men; and while he did not deny the importance of local causes as a teaching entity, he did question the importance that they had been given in the past. Howard, like many of us, had treated a certain number of Class III and open bite cases unsuccessfully. Some cases, after being apparently suc-

RELATION OF DISEASES TO MALOCCLUSION (HELLMAN)

DISEASE	NUMBER	CL. II DIV. 1	CL. II DIV. 2	OTHER CASES
Measles	186	34.94	13.97	51.07
Chickenpox	129	40.31	11.62	48.06
Scarlet fever	33	30.30	9.09	60.60
Eczema	14	28.57	14.28	57.13
Bronchitis	9	22.22	11.11	66.66
Whoopingcough	156	36.54	13.97	51.07
Asthma	2	0	50.00	50.00
Diphtheria	11	54.54	0	45.45
Pneumonia	22	36.36	4.54	59.99
Affection of the adenoids	191	37.74	13.08	49.21
Affection of the tonsils	164	34.14	14.02	51.82
Mastoiditis	5	40.00	40.00	20.00
Adenitis	19	47.36	15.79	36.84
Intestinal disturbances	37	27.02	10.81	62.16
Appendicitis	8	37.50	0	62.50
Convulsions	3	0	0	100.00
Nervousness	27	37.37	22.22	40.74
Anemia	4	50.00	50.00	0
Rickets	7	0	0	100.00
Rheumatism	6	50.00	0	50.00
Mumps	40	40.00	10.00	50.00
Finger, tongue or lip sucking habit*	90	60.00	2.22	37.77

*This habit, though not a disease, is included in the list merely for the sake of convenience.

8. Howard, C. C.: Study of Jaw and Arch Development Considered with the Normal and Abnormal Skeleton, Internat. J. Orthodontia, 11:214 (March) 1925.

cessfully treated, relapsed into their original condition, while others grew worse, or defied all mechanical agencies. Being interested in the study of endocrinology, and being fortunate in having an institution—the Good Samaritan Clinic—at hand where endocrine disturbances were being studied and treated, he associated himself with a group of medical men and began a study of the comparison of mouth and jaw deformities with those of other parts of the body. He reports three types of cases: those occurring in (1) cretins, and in persons suffering from (2) acromegaly and (3) hypogonadism. In cretins, the characteristic signs were

Fig. 1.—Casts of teeth of two mongolian idiots, showing dissimilar conditions of malocclusion.

deficient thyroid secretion, retarded growth, misshapen heads, retarded hair growth, short, stubby fingers, retarded mentality and always malformed dental arches. In acromegaly, the characteristics were overgrowth of the hands, feet and lower face. Howard concluded from the evidence presented in such cases that, once bone defects are established, reduction is impossible. He thinks that the orthodontist should recognize such conditions as beyond the realm of his field, and save the individuals useless expense and inconvenience. Let us think this over seriously: it may save us much future grief. In the hypogonads, the characteristics were retardation of sex development, marked disproportion in body measurements and invariable malformation of the dental arches. In fifty cases examined, not one failed to show malformation of the dental arches.

Howard believes that any individual with a disproportion in favor of long bones will present malocclusion of the teeth, and that all fat people with normal body measurements will present normal dental arches and normal occlusion. The evidence presented is not sufficient nor convincing enough to allow a general acceptance of the latter statement. Howard's study of 150 cases of preadolescent and postadolescent individuals in which a positive diagnosis of endocrine disease was made elicits the

Fig. 2.—Occlusal aspects of the upper arches of casts shown in Figure 1, showing similarity in shape (horseshoe shaped arch).

fact that he found malocclusion in every case; which is evidence that a positive correlation exists between the two entities. The greatest, or rather the most positive, correlation he found to exist between Class III cases and anterior lobe pituitary disease.

Dr. Howard is continuing his investigation, and is now at work making a correlation between the various types of malocclusion and wrist, hand and knee roentgenograms. He hopes to give us a report during the next year.

While on this subject, I wish to report that, in the last four years, I have had several mongolian idiots under observation and one under treatment; and while all of them presented malocclusion, no specific type was found. There did seem to be a strong resemblance between

the maxillae in shape. (Figs. 1-2.).

Scientific research may be divided into two fields: (1) the gathering of statistical evidence, and (2) animal experimentation. The above mentioned investigators, with the exception of McCollum, have worked in the field of statistics. Fortunately, another worthy member of our small group of workers, Percy R. Howe,[9] of Boston, interested in the field of diet and its relation to malocclusion, started to experiment with animals in an attempt to discover some of the etiologic factors in or causes of malocclusion. Mellanby[10] had studied the formation and calcification of the teeth and jaws of dogs as affected by diet, and interpreted her results to mean that some substance or substances similar in distribution to vitamin A have a potent effect as regards calcification of the teeth. Her later work (1923) shows that puppies fed on diets deficient in vitamin A during the period of the development of the permanent teeth showed one or more of the following defects of the teeth and jaws: (1) thick and poorly calcified jaw bones and alveolar processes; (2) irregularity in the arrangement of the teeth, as a rule more noticeable in the lower incisors, and (3) delay in and retardation of eruption of the permanent teeth.

McCollum and Simmonds,[11] working with rats in experimentation on dietary deficiency and observing, also, a number of human beings, came to the conclusion "that the small jaws and crowding of the teeth frequently seen in children of today is almost certainly the result of faulty skeletal development, and will be influenced by the dietary errors which favor the development of rickets." In the light of recent conversations with Dr. McCollum, this statement should be modified to include any dietary errors that might interfere with the calcium phosphorus metabolism in the child. This might include such diseases as tetany, anemia and achondroplasia.

It remained for Howe to apply the study of nutrition specifically to orthodontic problems. He thought that the standard works on orthodontics did not emphasize the idea that the primary cause of malocclusion lies in the field of nutrition. With this thought in mind, he fed a number of monkeys (*Macacus rhesus*) on diets that were deficient in either vitamin C, the antiscorbutic vitamin, or vitamin D, the antirachitic vitamin. His controls, which were of the same species, were fed on diets in which there was no deficiency. The former showed narrow arches and faces with the anterior teeth protruding, while the latter had regular teeth and broad arches. Conditions similar to adenoids and mouth-breathing were produced experimentally.

Howe thinks that the lack of breast feeding in children is largely responsible for the existing malocclusion, and argues that mother's milk, being a protective food, contains an abundance of the antiscorbutic vitamin, the lack of which causes bone and denture formation to cease. He reports that guinea-pigs fed on a diet deficient in this vitamin show both bone and dentin resorbed as early as at from 7 to 9 days, and that, on administration of the missing factor, new bone and dentin formed in twenty-four hours.

9. Howe, P. R.: Influence of Food on Malocclusion, Proc. First Internat. Orthodon. Cong., 1926.

10. Mellanby, May: Experimental Evidence Demonstrating Influence of a Special Dietetic Factor on Development of Teeth and Jaws, Dent. Rec., 40:63 (Feb.) 1920.

11. McCollum, E. V., and Simmonds, Nina: Newer Knowledge of Nutrition, Ed. 3, New York: The Macmillan Company.

Let us for a moment consider a part of Howe's conclusion. He says[9]:

> So great is the prevalence of maxillary deformities with their attendant malocclusion that we seem to have accepted them as a sort of necessary evil, and to have become so absorbed in remedial measures that we have neglected to study fundamental causes. If the studies in animal nutrition carried on in recent years by the Mellanbys, McCollum and others arouse the suspicion that in the matter of diet primitive man had the advantage of us, it would be well to interest ourselves more thoroughly in the subject in the hope of possible prevention.

This is well as far as it goes, and what Howe has done is notable. His conclusion that the primary cause of malocclusion lies in the field of nutrition has not been proved by any evidence that he has produced. He has certainly produced malocclusion in monkeys, and there is no question that diet is a factor which affects growth and development; but his work would be more complete and more convincing if, instead of making one kind of malnutrition experiment in monkeys, he would produce all kinds of deficiencies and study their effects. As an authority on nutrition said: "Howe should see in how many ways he can disturb the different structures."

What of the future? If we are to make progress, if we are to take our place in the biologic sciences, if we are to become a real force in health service, the work of these pioneers must be carried on, and other workers must augment this present small army. It may be asked what is being done now. What are the plans for the future? It is, indeed, encouraging to know that Hellman, Howard, Johnson, Howe and others are continuing in their efforts to solve some of the intricate problems relative to systemic conditions as factors in malocclusion. But new fields are opening, new workers are appearing; and the outlook for the future is very encouraging.

In an effort to correlate some of the work of the beforementioned men, and perhaps to add a little to the sum total of knowledge we now have, a little more than three years ago, I started a systematic study of a group of preschool children at the Merrill-Palmer School in Detroit. It was proposed that a group of 100 children be studied over a period of ten years in an effort to find out just what took place in the jaws and dental arches from the age of 3 to 15 years. These children were not to have any orthodontic treatment, but if at any time it became imperative to treat them, the study of such cases would end. In April, 1924, a group of children ranging in age from 3 to 5 years were placed under observation and after they had been subjected to a complete dental survey, plaster impressions of their dental arches were made. In September of the following years, Ira Lehman associated himself with me and together we started to make this complete study. Plaster impressions of the dental arches and teeth and measurements of the width and length of the dental arches of each child are being made once a year. This will supply a tangible record for the study of the changes that take place in the arches incident to growth and development and supply material for a dental growth curve. In addition to this record, medical histories, mental histories and diet histories are being taken, particular attention being paid to the prenatal, and immediate postnatal histories. The children attend the school until they are 5 years old; and after they leave, they return once a year, when impressions, histories and measurements are taken. In this way, we are able to gather a complete record of each child,

and the necessary correlations can be made which we think will aid us not only in studying normal and abnormal growth and development, but also in studying the possible factors that are operative in producing malocclusion. To make the study more complete, I am making a special study of the growth of the head and face, using standard anthropometric methods, and it is my hope that roentgenographic records will be made for each case in the near future. The school already has hand and wrist roentgenograms for every child, and there seems to be a correlation between them and our particular field. To date, there are more than 100 children under observation, and while some will be lost by removals or indifference and from sundry other causes, there is every reason to believe that, at the end of our ten-year study, there will be in the neighborhood of 100 complete records. These records will be turned over to the dental profession, and if the facts gathered succeed in augmenting our knowledge of etiologic factors, our efforts will have been well repaid.

While it is too early to come to any definite conclusion, we feel safe in saying that the investigation so far gives indication of new and important knowledge concerning growth, development, diet and disease processes as they relate to malocclusion. But, unless others take up this study, so that comparison can be made, the final results will not be so valuable as they should be. Since this study was started, some investigators in Teachers College, Columbia University, have started a similar work. My associate and I are now looking forward to others taking up the work. The Merrill-Palmer School has records, blanks, methods, etc., which it will gladly turn over to any one interested in the study.

We have seen that systemic conditions do act as factors in producing malocclusion, in one way or another, and that textbook material is not as a rule reliable. On the other hand, we have seen that because of this, work has been done which has yielded a fund of information bringing some light out of darkness. And, as time goes on, we shall know more and more of the truth about systemic conditions as causative factors in malocclusion. The signs of the future are encouraging, indeed. Though much is yet to be accomplished, such investigations as have been made point to this conclusion, which answers the introductory questions: There exists such an entity as systemic conditions acting as causative factors in malocclusion.

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DISCUSSION

Lloyd S. Lourie, Chicago, Ill.: There seem to be two outstanding features of this paper —the first, a review of orthodontic literature, particularly textbooks, with their more or less generally accepted theories, and the second, a consideration of the more recent scientific investigations. Dr. Lewis' review of the literature and current theories is generally accurate, though one might question the advisability of selecting only one writer for special criticism because he expressed views current at the time. I agree that many of the theories published in textbooks were based upon insufficient evidence and consequently are not dependable. This may be the reason for commending one well-known writer who almost entirely avoided this important subject except for the one sentence which has been quoted as follows: "Most of the immediate causes are mechanical, yet whatever acts as a hindrance to Nature in performing her delicate offices in the unfolding of the various tissues composing the dental apparatus will be operative as a cause in producing malocclusion." This is a truthful statement beautifully expressed, but I doubt that it "supplied the impetus" for investigation as much as did the more definite though sometimes inaccurate statements of other writers. The very lack of evidence for

some of their theories and explanations provokes the desire to counteract them with the truth, thus stimulating investigation. Of course, such unproved suggestions are liable to be wrongly applied. For example, scarlet fever or measles is sometimes given as the cause of hypoplasia of the enamel, even though the disease may have occurred as late as at 3 or 4 years of age, long after the time when the affected enamel was calcifying and possibly subject to injury from such a disease. The days of unsubstantiated theories are passing and the important part of this paper is the report of actual results of scientific investigation. It is interesting to note that none of them except those on endocrines show any direct connection between systemic conditions and particular forms of malocclusion. Howard found a definite connection between acromegaly and mandibular prognathism, which, however, accounts for only one form of Class III, or mesioclusion cases. These scientific investigations so far corroborate the theory that systemic factors are predisposing or basic, while local factors are the form-determining ones. The most impressive part of the report is that several investigations, both statistical and experimental (animal) present such convincing evidence of the importance of diet deficiencies as systemic causative factors in malocclusion. It is encouraging to know of the various new investigations being undertaken, and I wish to pay my respects to the two men who are ambitious enough to attempt such a ten-year research program as that of the Merrill-Palmer School. We cannot all be research workers, but most of us could easily be more careful observers and keep more accurate case histories. A uniform record chart would make such histories of far greater value for compiling statistics.

Hugh G. Tanzey, Kansas City, Mo.: I want to add to Dr. Lourie's words of encouragement for men who take up this class of investigation, and for those that have never attempted anything of the kind, I want to say that it is expensive, requires much ingenuity, some intelligence and a great deal of patience. We attempted to start something similar on a much smaller scale at our school in Kansas City last year. It required so much time and patience that we did not get very far with it. Whenever we find such men as Dr. Lewis, Dr. Johnson, Dr. Howe and Dr. Hellman, we should endeavor to back them up financially and in every other way, because they are going to discover something. We can do quite a little along the line of prevention by getting the cases early, which unquestionably prevents malocclusion. We sometimes get overawed by reports from the scientists and feel that we should carefully select the cases that we are going to treat, but the older men know that many times they are surprised and delighted to find that they have taken cases thought to be entirely hopeless and have obtained beautiful results, and they have taken cases that looked very easy and have met with little less than disastrous results. So we should not get discouraged, but should do what we can to the best of our ability.

Dr. Lewis (closing): Dr. Tanzey speaks of the difficulties in research. It is the difficulties that make the work interesting. As far as being prepared for research, neither Dr. Lehman nor I ever had any experience whatsoever. I asked E. V. McCollum, who is our advisor at the school, if he could tell me anything about conducting research. He told me that we would have to do just as he did when he first started: work and learn by experience. That is what we are doing now. We have done many things that were not necessary, and we are continually changing our methods as time goes on. To those interested in orthodontic research, we are glad to give the benefit of our experience in any way possible. Of course you must realize that, in a work such as we are undertaking, an adequate amount of money is necessary for certain necessary expenses, though nothing goes to either of us personally. The Merrill-Palmer School has an endowment of practically $6,000,000 with which to carry out the various pieces of research work. What Dr. Lourie has in mind is undoubtedly true to a certain degree, yet I think that the early research workers were influenced to no mean degree by Dr. Angle's statement.

PORCELAIN INLAYS AND THEIR SUBSTITUTES*

By MALVERN DUMAH HUFF, A.B., D.D.S., F.A.C.D., Atlanta, Ga.

IN the preparation of this paper, it has been very interesting to search in recent dental literature for the methods others have used in presenting similar subjects. It is evident that porcelain became quite "a fad" about thirty years ago, and owing to crude apparatus and because of various other limitations and difficulties, it was soon passed into the discard by many of its erstwhile devotees.

But as with all things worthy, there were some old faithful pioneers who caught the vision of its possibilities, and they labored on, striving for the esthetic, the permanent. Two things resulted from their efforts: they were rewarded by greater achievements, their names are immortal, and mankind has been and will continue to be benefited. Credit in this connection goes to Jenkins, Capon, Spalding, Thompson, Land, LeGro and others. Every man who emulates their example and strives for the most perfect imitation of nature and the concealment of his art will be elevated to higher planes of thought and living.

The papers appearing since 1920 indicate great interest in porcelain—a very encouraging fact—but it is also true that in these papers we see many references to substitutes; which brings me to the consideration of the greatest calamity that has befallen the dental profession and the world at large since the profession has been so called.

Many men today are digging their professional graves with an agate spatula and a celluloid strip. This, of course, is a grievous thing to contemplate; but the worst of it is that countless numbers of teeth are passing out of usefulness because of the indiscriminate use of substitutes for baked porcelain. Substitutes at best are but cheap imitations, and when we are dealing with human life, we have no moral right to substitute, using the puny plea that the patient will not pay.

The only argument left to the advocates of silicate fillings is that it saves times for them and the patient. I answer that with this question: What does it profit a man if he saves a little time and loses many teeth?

There are certain places where a conservative man may use silicates; i. e., in small pits and fissures and in approximal anterior cavities when they are too small to receive baked porcelain. In no case should synthetics be placed in contact with the gingiva; for, in every case, the filling becomes rough and porous, collects food products and bacteria, and finally causes irritation and its sequelae.

Silicates are contraindicated in heavy approximal restorations because they will not maintain a normal contact, for, within a few months, the contact is gone and the teeth are allowed to come together at the gingiva. Pinching of the

*Read before the Section on Operative Dentistry, Materia Medica and Therapeutics at the Sixty-Ninth Annual Session of the American Dental Association, Detroit, Mich., Oct. 26, 1927.

gums and periodontoclasia are direct results of this practice.

We are instructed that deep-seated cavities should be lined with cement, and this would save some of the dire results of these fillings. When the proper precautions are not taken, the pulp will die, just as surely as if arsenic had been sealed in the cavity, though not quite so rapidly.

The use of silicate as a temporary crown, in conjunction with porcelain jackets, justifies its existence, but if the tooth is vital, it should be dried off carefully with warm alcohol, then painted with a solution of chlor-resin, then with a thick coat of liquid lining.

INDICATIONS FOR PORCELAIN INLAYS

Practically all labial and buccal cavities, as far back as the second molars, can and should be filled with porcelain, if they can be filled with anything. Porcelain is most acceptable to the soft tissue and will not cause recession or irritation. The fact that the anatomic form of the tooth and normal tension on the gingival tissue can be reproduced and maintained is the best possible argument in favor of this procedure.

Almost all approximal cavities in the anterior teeth should be filled with baked porcelain. The occlusal, mesioclusal and distoclusal cavities of the bicuspids and molars require something stronger than porcelain inlays for the best results. When not more than one-third of the incisal edge of the anterior teeth is involved, porcelain inlays are indicated in the six anterior teeth.

CAVITY PREPARATION

Failures in this work come from carelessness in cavity preparation more often than from any one detail. Success comes from the ability to carry out every detail in the entire technic with precision. Others have given such concise instructions on cavity preparation, and because this question alone would fill the time allotted this paper, I shall pass over it and present as quickly as I can the technic used in making inlays, for this phase of the subject has not been so fully covered. It is well for one interested in this work to master both the direct and the indirect methods of making matrices.

Direct Method.—In simple approximal cavities, it is usually most convenient to use the direct method, if the operator can secure sufficient separation to enable him to remove the matrix without distortion and with sufficient excess. In all other cases, the indirect method is most decidedly indicated.

Linen tape of convenient width is drawn over the platinum to hold it in place and to prevent the development of springiness, which is produced when burnishers are brought into direct contact with the foil. The weak point in the direct method is the inability to produce matrices with sufficient excess to prevent warping due to adhesion of the porcelain when it is baked, and shrinkage takes place. This element of error can be eliminated best by using the indirect method.

Indirect Method.—I advocate the indirect method in all cervical cavities and in many compound cavities in the anterior teeth. Accurate impressions may be made by using modeling compound cones (suggested by the Detroit Clinic Club) of suitable size in the average cervical cavity; in those more complicated, an improvised tray cut to fit from sheet metal, 30 gage, and made to carry a proper amount of softened compound to place to be chilled thoroughly.

By cutting 36 gage German silver and folding it into a box, of which two sides are left open, and using a little soft

solder to hold the folded sides to place, we can obtain splendid impressions of compound cavities in the anterior teeth. Equally satisfactory results may be obtained by using annealed seamless copper bands adjusted to the tooth. In order that we may avoid air pockets at the gingival portion of the cavity, we drill a hole in the band with a No. 1 bur at that point. These impressions must be kept cool until the amalgam die is made. The dies should be made of amalgam of high edge strength so that it will not change shape in burnishing or swaging the matrix, or in the subsequent swagings sometimes necessary between the first and second biscuit bakes.

To John Murphy, of London (1837), belongs the credit for introducing a platinum foil technic which made possible the present-day porcelain inlay. The matrix of 1-1,000 platinum foil should extend over the margins of the cavity at least 3 or 4 mm. in order that after it is burnished, the excess may be folded on itself about 1 mm. over the entire periphery of the matrix. Then the matrix and the die are wrapped together in tissue paper and placed in a "moldine" swager, and, with a gentle tap, a perfect adaptation is obtained, and the cavity is encircled by a strong reinforced excess which will resist distortion and shrinkage in a most satisfactory manner. This method is preferred because the shading of the porcelain is undisturbed and unaltered by the old-time cutting and dividing idea. This enables the technician to place the dentin shade and the enamel shade in position as predetermined and have it come through in that proportion.

In the larger restorations, a second swaging always produces more or less checking of the porcelain, but the lines are almost microscopic and they unite perfectly in the next firing. We find that the porcelain shrinks toward the base of the cavity instead of pulling away from the margins when we use this method and pack and dry out the porcelain thoroughly.

We believe that the day of low fusing porcelains is gone. It is admitted that high fusing porcelain is stronger. Therefore, it is illogical to use weak porcelain because we happen to be making an inlay.

Great credit is due Weston A. Price for the introduction of the pyrometer. A most valuable accessory in the electric furnace, the pyrometer on the furnace of today has brought the baking of porcelain to an exact science, or nearly so, and there is no excuse now for overfused inlays and crowns. I have passed through all the stages of development of the porcelain art from the gasoline torch set behind a fire clay muffle, of twenty-seven years ago, to the present splendidly accurate apparatus, and I appreciate the evolution.

There is nothing new to suggest in the baking of inlays, but it is most important to remember that porcelain should never be brought to a completely fused state until the last time that it is to go into the furnace. Otherwise, porosity and loss of shade may result. The matrix should be left on while the inlay of a contact point or incisal angle is being restored, until these points are checked up. This is one of the important points in this work. The length and width of a compound inlay should be cut on a bit of cardboard to guide the laboratory assistant, also.

ETCHING

The best possible surface to aid in retention is secured by etching the inlay, and forty-five seconds only will be re-

quired for full strength hydrofluoric acid. The textbooks say five minutes, but they cannot be referring to present-day acid.

If the inlay was made by the indirect method, we place it in the die, press the softened surface of yellow wax down on it, chill it and remove. This protects the outer surface and exposes the portion to be etched. After forty-five seconds, it is washed in running water for a minute or two, then in alcohol. Be sure that no white powder coats the surface when the piece is dried.

Do not use sodium bicarbonate to counteract the acid. It would be decidedly better to have the surface slightly acid than alkaline, for it would have a tendency to affect the acid in the cement. It is preferable to have it neutral by thorough washing.

CEMENTATION

We can defeat our purpose at this point in two ways. We can set the inlay with a synthetic cement or we can use the wrong shade of cement; and of these the latter is least harmful. There can be no argument in favor of synthetic cement in this connection because it renders the tooth sensitive and is not sufficiently adhesive. It is impractical also because the inlay cannot be seated if enough powder is worked into the mixture to neutralize it.

A great many failures in porcelain work can be traced to improper cementation. I have used Harvard quick setting cement for twenty-seven years, and find that I can combine different shades of it in such a way that the mix will blend in with the tooth and the porcelain in a very satisfactory manner. There is no one shade of cement that alone will be suitable for many cases, but if we select two shades, say brown and light yellow, as suggested by Dr. Spalding, of Birmingham, Mich., beautiful results may be obtained.

When the cement is placed in the cavity, the cement remaining on the instrument is used to pick up the inlay and convey it to place, and thus marginal fracture and the danger of dropping the inlay are avoided.

I do not claim to have originated the foregoing technic, but I wish to recommend it to any one interested in becoming proficient in porcelain inlay work.

DISCUSSION

Albert Leland LeGro, Detroit, Mich.: Aside from the other excellent points Dr. Huff has brought out, his admonition against the casual use of synthetic porcelain cements is one to be seriously considered. We have constantly called attention to the harmful effects of this material, employed as it is by many operators of widely varying abilities. Observation has shown that to make a perfect synthetic porcelain cement filling, even where it is indicated, requires rare skill, and those operators who are obsessed with the idea that this material can be employed, and is indicated, in all cavities of anterior teeth are inviting eventual disaster, the major burden of which must be borne by the unsuspecting patients. Stress is laid on the fact that "failures in this work come from carelessness in cavity preparation," and in view of the fact that other technic in the construction of porcelain inlays is described, some description of cavity shapes at least should be given consideration. Unfortunately, a book written by John Quincy Byram many years ago is not now available. Byram's illustrations of cavity preparation and shapes have never been improved on, and if we were called on to write exhaustively on this subject, we could but reiterate what he has taught and commend the cavity preparations which he so ably devised and illustrated. In regard to the relative merits of the direct and indirect methods, it seems that much more is to be said in favor of the indirect. Wherever a good impression of any cavity can be obtained, the possibilities of constructing a perfect inlay are infinitely greater and never have we seen inlays so nearly perfect in fit and with fine borders made by the direct method. It would seem that high

standards and ideals would not see the need for an argument in the matter. Where proper access for impressions is not available, it then, of course, becomes necessary to use the direct method, but from the standpoint of absolute perfection, porcelain inlays constructed by this method are not the equal of the others. There are a few highly skilled technicians who make the exception form the rule, and this unusual skill generally goes hand in hand with many years of constant experience and application. The practice of swaging matrices except as an auxiliary stage in the completion of the matrix is to be discouraged. While it is true that the swaging process carries the platinum to all surfaces of the cavity and leaves no false surfaces, there yet remains one of the most essential procedures in matrix construction; namely, fine ironing or smoothing of the outlines of the cavity border, followed by heat treatment for removal of tension. In the construction of a matrix, the platinum becomes springy with tension and should be annealed, not only once but several times if necessary, until, by alternate application in cavity and heat treatment, the final condition of the platinum is one entirely without tension. This may be accomplished by heating to 2,300 degrees in an electric furnace or by use of the blowpipe, either oxyhydrogen or gas, on a perfectly clean, and preferably new, charcoal block, and heating the platinum to incandescence. By reducing the tension to the minimum, some of the difficulties encountered in getting closely fitted borders are thus negotiated. It is by no means the sole factor in obtaining good fits, for there is, in addition, the problem of porcelain physics to consider. The two most important requisites of a finely fitted inlay are perfect seating and perfect borders, and the more important of the two is the fine border, fitting without ragged edge that will eventually fracture off in minute particles. The cavity borders should be so cut that the surface angle, by virtue of the hard enamel in which it is cut, leaves a decided sense of sharpness, like the surface angle on a cleanly cut piece of plate glass. A matrix carefully ironed over such an angle permits of the finest inlay border in the finished work and also renders the construction simpler. These angles should always be at right angles to the segment of the surface circle of enamel where cut, and this is best accomplished, not by stones, but by new finishing burs of the short cylindrical type, leaving a highly polished surface. Reinforced excess platinum is undoubtedly of some value in resisting distortion and adaptation, but not wholly necessary when other precautions are known. If a great deal of excess is left, imbedding in the finest granular silex, not powder, accomplishes the same results. New granules must be used each time, which necessitates time that is not always freely given. Platinum 1-5,000, except in very large inlay construction, is infinitely superior to 1-1,000, though more difficult to handle on account of its thinness. When large complex fillings are constructed, it seems preferable to strip the matrix from the inlay before final fluxing and place the inlay in the newly constructed matrix for final work rather than to reswage, which does not permit of such perfect work. As to low fusing porcelains, Dr. Huff does not describe what he means by low fusing. In labial, buccal and lingual cavities, the so-called low fusing porcelain displays great edge strength and is ideal for such inlays. Fusing as it does several hundred degrees below the block bodies, the work is facilitated and much less time is consumed in firing. The pigments do not burn out, and as fine results are possible as with the use of higher fusing bodies. In connection with this, I have been talking with engineers of a dental manufacturing company and they assure me that the edge strength of the low fusing porcelain bodies that they have do not contain too much feldspar and are as strong as the high fusing bodies. There is no objection, therefore, to people using the high fusing bodies that they prefer. Solid color inlays are never so effective in appearance as the two-color inlays. Solid color or one color inlays eventually look artificial, while two-colored inlays, when there is a graduation from dark to light, even if a bit off shade, make very superior inlays as far as esthetics is concerned. Translucency is never achieved in one color inlays, and with the added curtain of cement behind them, they often look opaque owing to absorption of light rays by the cement. In considering the pyrometer, do not be deceived by the fact that the instrument records on the dial the exact heat in the muffle. Time must always be the important factor in firing porcelain, and without that provision, the pyrometer is useless. The pyrometer merely records the heat, but porcelain fuses most perfectly when given

a certain definite time at a certain definite temperature, so one really depends on the other. Another important factor in inlay construction is that of packing porcelain and the laying on of shades. It is recognized that Dr. Huff knows this subject well, and it was hoped that he would describe his particular method for there are several in use at this time. A perusal of the literature on the subject of porcelain inlay construction fails to reveal any adequate description of this phase of the technic, which leaves the average student of the art to work out a method of his own.

S. Levy, Scranton, Pa.: I did not quite get what Dr. Huff meant when he referred to allowing platinum to remain in place where he restored the angle or contact point. Did he mean the inlay or platinum in place?

John J. Travis, Ann Arbor, Mich.: I am glad that Dr. Huff has spoken quite strongly regarding the use of silicate as a substitute for the porcelain inlay. I have been associated recently with a group working to determine the effects of silicates on the pulp. Nothing very definite has been developed. We first wished to find out whether silicate cement made as tight a filling as oxyphosphate cement, and we found it was far inferior to oxyphosphate and amalgam. We found that it did not afford perfect sealing of the cavity. It has been shown that when oxyphosphates or silicates dissolve, free phosphoric acid is given off. When oxyphosphates dissolve, they dissolve from the exposed surface, and it is not from the caval surface that that dissolution takes place; whereas, with the silicate body, it is dissolved from the crypt from around the edge of the filling which throws the free phosphoric acid in contact with the caval surface of the tooth. In that way, we may account for the death of the pulp under many silicate fillings, because many have been left in after they should be removed. Another question of interest is the neutralization of the hydrofluoric acid used in etching inlays. I have long been in favor of neutralizing acid by the use of sodium bicarbonate. It is just as easy to wash off the bicarbonate after neutralization as it is to wash off the acid. We know that acid does penetrate porcelain much farther than water would because it takes a long time before the bubbles will cease to arise after placing in the bicarbonate solution.

T. E. Braley, Chattanooga, Tenn.: I want to ask Dr. Huff his opinion regarding cryptex.

Victor Jordan, Evansville, Ind.: Dr. Huff speaks of two color inlays. I should like to ask him to describe his method of laying on the colors.

Dr. Huff (closing): I have no apology to make for the fact that some points in baking and making inlays were necessarily curtailed and possibly eliminated. In reference to the criticism of the plan of swaging before the first biscuit bake and the second biscuit bake; I have used the silex investment and silex powder. I have used the checking and dividing, letting it shrink away from the center as it does when we divide it. I have discarded both of those for what I have found to be the best technic. I stressed the point that we must use a high grade of amalgam and use enough of it to make certain a die that will stand swaging. If we do that, we will make better inlays. It is not an experiment. I advocated the use of high fusing porcelain and I have a definite reason for that. I have used every kind of porcelain that has been brought out in the twenty-seven years that I have been practicing—I use high fusing porcelain for porcelain jacket work and porcelain inlays, because I can get better shades and imitate nature. I can get better shading by using one kind of porcelain and in switching from one to the other and varying the time element. Dr. LeGro says that the pyrometer is not the only factor to be considered, and it certainly is not. The only thing it does indicate for us is the exact temperature of the interior of the furnace. Now, we have one definitely known thing. If we have difficulty in that, fuse the gold and watch the pyrometer. By using the pyrometer, we eliminate certainly one element of inaccuracy. It leaves only one variable. If we use one kind of porcelain that fuses at the same temperature in the same length of time, that is fine. The only thing we have to change in fusion is to use the porcelain of the same size and note the difference in time to fuse or bake a crown. That is the only variable.

Dr. Levy asked why I leave the platinum. I leave the platinum on the inlay until I can fit it in the mouth, so that, if I need to add a little or if I need to grind it, I can put

it back in the furnace and fuse or add to it and fuse. It is in the interest of accuracy that I leave the platinum. The last thing I do before setting is to strip off the platinum, etch and cement. Dr. Travis spoke of research. We are going to find out many things in research and it is a splendid thing that that is being done. The study club in Atlanta to which I belong, years ago, in the old days of synthetics, did a little investigation on its own account when we were all killing pulps so promptly. We found arsenic in one variety of synthetic. We found it with the Marsh arsenic test. When the matter was brought to the attention of the manufacturers, they improved the article and removed the arsenic. I do not believe that we are killing pulps today with arsenic but we are doing it slowly and as surely as we did with arsenic.

In reference to washing with sodium bicarbonate: if we are thorough in either case, it does not matter how we arrive. If we stop the washing before we get rid of the sodium bicarbonate, we have done more harm than if we stopped washing before we have gotten rid of the last trace of hydrofluoric acid. Do not think I am advocating leaving the hydrofluoric acid; but if a trace is to be left, it is better that it be the acid. About cryptex, it is neither oxyphosphate nor is it synthetic. It is a cross between the two. It is not sufficiently adhesive and it does not give the protection to the pulp that oxyphosphate does. I warn you that cryptex will make a doubtful setting material. It is an esthetic find, but if we put in a contour restoration with cryptex, some one of these days, our patient will bring it back to us wrapped in a little piece of tissue paper in the corner of an envelop. I am not telling you "perhaps or maybe." I have been seeing these cases. I put inlays in with cryptex when it first came out. Dr. Jordan asked about the use of two colors. If I want to make a blend as nature does, I will put in so much of the dentin color and so much of the enamel shade, and it does not take long to find out the proportions to use for a certain shade. If you wish, you can put in more of the dentin and let the enamel shade off to a feather edge at the cervical. I am not advocating the use of porcelain inlays because they are simple, because they are easy to make or because they take but little time. It takes more time and study to duplicate what Nature put in a tooth. We have to do it by working hard at it and after we have once mastered it, we can do it ever after. The question was asked about the phosphate cement used in this work. I mentioned that we cannot use one shade of cement and duplicate definitely and accurately the shades of the tooth, but we can train any intelligent assistant at the chair to take two or three shades of cement and blend them in such a way that we can match the shade of the tooth perfectly. Lay the inlay down by the slab and tell the assistant to mix a light, medium or dark combination. I pick out the colors to use. I direct that much. Then the assistant duplicates as nearly as possible the shading in the inlay.

MORPHOLOGIC CHANGES IN BLOOD FOLLOWING THE EXTRACTION OF PULPLESS TEETH*

By A. W. BRYAN, D.D.S.; F. D. FRANCIS, B.S., D.D.S.; HELEN FITZGERALD, B.A., and J. W. BURKE, Iowa City, Iowa

THE belief that certain characteristic morphologic changes take place in blood in the presence of chronic infections is not new to the medical profession. Many articles along this line have appeared in past years, and these have been especially numerous since interest in chronic dental infections has become so keen.

Three years ago, we realized that much readily available material for study in this field was being wasted, because of the failure to obtain histories and results in the case of clinical patients who had possible foci of infection removed. They were allowed to go after the operation, with no check-up except for the occasional outstanding case in which clinical symptoms showed marked improvement. In the belief that a great deal of knowledge was available from these cases, a laboratory was equipped so that practically all phases of chemical, bacteriologic or biochemical work could be followed. The problems that could be undertaken were numerous, but it was determined that one problem should be selected and concentrated on.

THE PROBLEM

In a clinic in which from 6,000 to 7,000 patients are examined annually, a large percentage are found to have pulpless teeth. The removal of these teeth is indicated in many cases, the reasons varying from the necessity of making prosthetic appliances to the systemic conditions of the patients. We determined that the problem to be followed was that of morphologic changes in blood subsequent to the removal of these pulpless teeth. All changes which might follow the removal of the teeth could not be positively credited to this operation, but if certain changes occurred regularly after this procedure, they could be quite logically attributed to the removal of sources of infection.

THE LABORATORY

It was decided that the most accurate work possible must be done. The best of instruments and materials that could be obtained were furnished to the technician. All blood counting pipets were certified. This was necessary not only for the accuracy of each individual count, but also because it obviated the necessity of using the same pipet for subsequent checks on each patient. A Dare hemoglobinometer of the latest

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type was used for all hemoglobin readings. A desk type Baumanometer was used for determining blood pressure. Wright's stain was used for differential counts.

ROUTINE FOR HANDLING PATIENTS

Arrangements were made with those in charge of the examination room to send to the laboratory all patients who had pulpless teeth marked for extraction, before any operating was done.

As complete a family history as it was possible to obtain was taken. The history extended back to the grandparents on both sides of the family, if the patient was able to furnish this information. These records were for use in another investigation. Radiograms of all pulpless teeth were filed with the histories. Blood pressure readings were recorded. A hemoglobin reading was made from finger blood and, from the same source, a total red and white count and two slides for the differential count. In most cases, a urinalysis was made.

After the examination outlined above, the patients were instructed to proceed with the work indicated on their examination charts, and to report for further questioning and observation within a month after the teeth were removed. Check-up counts were made at monthly intervals when possible.

The work extended from October to June of the following year. Obviously, those patients who had the preliminary examination late in the school year could not have more than one or two check counts. For the same reason, shortness of time, the readjustment in the blood condition of this group was incomplete at the close of the school year.

Those who have had experience with patients in a large clinic are aware of the fact that it is very difficult to keep them under observation over a long period of time. Those who live in communities remote from the clinic do not care to return for observation after their restorative work is completed. For this reason, many interesting cases are lost, as far as records of biologic changes are concerned.

Many patients who had the initial blood count made did not return to have their work completed, having come for advice only.

CONTROLS

As far as it is possible to control biologic experiments, this was done. Since the majority of our patients had the first count made in late fall or early winter, and the final count in late spring, it might be assumed that any changes in the blood picture were due to the effect of sunlight, fresh air and exercise after the shut-in life of winter. To offset this factor, we scanned our list for patients who had submitted to the preliminary examination, but, for one reason or another, had never had their work done; that is, had never had their pulpless teeth removed. Theoretically, if changes in the blood pictures of the group operated on were due to seasonal benefits, the same percentage of control patients should show the same general changes. But this was not the case, and the control group furnishes some interesting material for study.

WIDE VARIATION IN BLOOD PICTURES

An interesting fact coming to our attention in the examination of these patients was the wide variation in the blood picture, especially in the white cell count. In many cases, the total white count was found to be well above the average of that of health, and the differential count showed an increase in polymorphonuclears. In practically all the cases of this type, we were able to

find an active infection present: a suppurative periodontoclasia, an active Vincent's infection or an acute cold. Those patients who complained most of the symptoms ordinarily accompanying a chronic infection, and who were free from active periodontal disease, showed the most characteristic changes in the blood picture.

AVERAGE BLOOD PICTURE OF HEALTH

Individuals vary in all physiologic processes, but variations above or below the average taken from a group of healthy people is quite limited. For instance, temperature, pulse rate, respiration rate, blood pressure and other functions and processes vary but little except as the variation indicates pathologic conditions.

Recognized workers in hematology vary somewhat in their opinions as to what constitutes a so-called normal blood picture. Stitt[1] gives the average total number of red cells as from 5,000,000 to 5,500,000 per cubic millimeter for males. Hemoglobin is placed at from 90 to 110 per cent. The white cell count is given as nearly 7,500 per cubic millimeter. The red cell and hemoglobin figures are slightly lower for females. For the differential white count, the same author gives for polymorphonuclears, from 65 to 70 per cent; small lymphocytes, 20 to 30 per cent; large lymphocytes, 2 to 6 per cent; transitionals, 2 to 4 per cent; eosinophils, 1 to 2 per cent; mast cells, 0.25 to 0.50 per cent.

In our work, the polymorphonuclears and the small lymphocytes are of the most interest. Some writers place the polymorphonuclears at from 65 to 75 per cent; so it seems reasonable to accept 70 per cent as about the average. From 20 to 25 per cent seems to be agreed on by most writers, for the small lymphocyte count. Keeping in mind these figures, 70 and 22, will make it easy to compare individual blood pictures and determine quickly how nearly the patient is approaching the picture which is assumed to indicate chronic infection.

1. Stitt, E. R.: Practical Bacteriology, Blood Work and Parasitology.

CHANGES IN BLOOD PICTURE FOLLOWING THE REMOVAL OF PULPLESS TEETH

The figures which follow are the averages for a group of forty-one patients who had pulpless teeth removed, and returned for one or more check counts. The change is based on the last count made.

Hemoglobin seems to be especially susceptible to the action of chronic infection. The average hemoglobin reading, taken before any extracting was done, was 61.5 per cent. At the last count it was 71.6 per cent, an average increase of 10 per cent.

The average total red count at the beginning was 4,182,950, and at the end of the test, it was 4,281,500. The white count started at 8,675 and ended at 7,685. Large lymphocytes started at 6.3 per cent and closed at 5.06 per cent. The small lymphocytes, a type in which we were especially interested, were 25.68 per cent at the start and 23.51 per cent at the close. The polymorphonuclears, another important type, averaged 62.2 per cent to begin with and finished at 66.8 per cent. Bear in mind that in this group are some of those individuals, spoken of in a previous paragraph, who have an active infection in the gingival tissues, with blood pictures tending somewhat toward the acute rather than toward the chronic type. These cases, being counted with the group, tend to raise the polymorphonu-

clear count and lower the small lymphocyte count. It will be noted that the results show a favorable increase in both hemoglobin and polymorphonuclears in this series of forty-one patients. Table 1 shows these changes clearly.

Compare carefully the results in Table 1 with those in Table 2. We stated, in a preceding paragraph, that the controls furnished interesting material for study. If any factor other than the removal of the pulpless teeth accounted for the improvement in blood pictures in the group operated on, the controls should show the same change. Table 2 shows that there was practically no change in the average of the thirteen controls. There were only two or three patients in this group who showed any change of consequence, some of them even presenting poorer pictures at the close than they did at the start.

The average hemoglobin of the control group at the beginning was 67.8 per cent; at the close, 66.5 per cent. The red cells numbered 4,242,961 at the start and 4,180,769 at the close. The white cells, at the beginning, numbered 7,554, and at the end of the test, 7,215. The small lymphocytes began at 28.7 per cent and ended at 28.4 per cent. The polymorphonuclears, in the beginning, numbered 59.8 per cent; at the close, 61.7 per cent. Table 3 shows detailed records of the thirteen control cases. The slight changes may be noted.

TABLE 1.—CHANGES IN AVERAGES IN A GROUP OF FORTY-ONE PATIENTS WHO HAD PULPLESS TEETH REMOVED.

	Hemoglobin Per Cent	Red Cells	White Cells	Large Lympho-cytes Per Cent	Small Lympho-cytes Per Cent	Poly-morpho-nuclears Per Cent
First count	61.5	4,182,950	8,675	6.30	25.68	62.2
Last count	71.6	4,281,500	7,885	5.06	23.51	66.8

TABLE 2.—CHANGES IN AVERAGES OF CONTROL GROUP OF THIRTEEN PATIENTS WHO DID NOT HAVE PULPLESS TEETH REMOVED.

	Hemoglobin Per Cent	Red Cells	White Cells	Large Lympho-cytes Per Cent	Small Lympho-cytes Per Cent	Poly-morpho-nuclears Per Cent
First count	67.8	4,242,961	7,554	6.3	28.7	59.8
Last count	66.5	4,180,769	7,215	5.3	28.4	61.7

INDIVIDUAL REPORTS ON OPERATIVE CASES

The comparison of the tables of averages of operative and control cases shows clearly that an appreciable change for the better took place in the blood pictures after the removal of possible foci of infection. An examination of a few of the individual case reports of the operative cases will show the extent of some of these changes in a more definite way. The reason for this has been

TABLE 3.—INDIVIDUAL CONTROL CASES*

Case	Hemoglobin Per Cent	Red Cells	White Cells	Eosinophils Per Cent	Basophils Per Cent	Transitionals Per Cent	Large Lymphocytes Per Cent	Small Lymphocytes Per Cent	Polymorphonuclears Per Cent
1	68	3,830,000	9,800	1.0	.....	4	6.0	31.0	58.0
	64	3,670,000	6,600	.....	1	2	5.0	27.0	65.0
2	72	4,060,000	8,800	2.0	.....	1	7.0	31.0	59.0
	72	4,250,000	7,400	1.0	1	1	6.0	27.0	62.0
3	58	4,240,000	6,600	4.0	.....	5	8.0	28.0	55.0
	54	4,080,000	6,800	1.0	.....	4	6.0	29.0	60.0
4	55	3,840,000	9,200	2.0	.....	2	4.0	28.0	64.0
	62	4,260,000	6,400	1.0	.....	4	2.0	27.5	65.5
5	60	4,240,000	8,000	1.0	.....	.....	7.0	35.5	55.5
	62	4,020,000	7,000	.....	.....	4	6.0	31.0	59.0
6	80	4,986,000	5,600	2.0	.....	5	4.0	32.0	56.0
	78	4,450,000	6,600	1.0	.....	2	7.0	32.0	58.0
7	84	4,030,000	7,600	2.0	.....	5	4.0	24.0	65.0
	76	4,210,000	6,000	.....	.....	4	4.0	25.0	67.0
8	65	4,100,000	8,000	.....	.....	4	5.0	29.0	62.0
	64	4,270,000	9,200	1.0	.....	6	8.0	25.0	60.0
9	60	3,850,000	7,000	0.5	.....	3	7.5	33.0	56.0
	56	3,960,000	7,200	1.0	.....	3	4.0	33.0	59.0
10	68	4,116,000	7,200	1.5	.5	3	6.5	29.5	59.0
	74	4,120,000	7,200	2.0	.....	5	4.0	28.0	61.0
11	84	5,122,000	11,600	1.0	2	5	9.0	24.0	59.0
	70	4,260,000	9,000	2.0	.....	4	7.0	28.0	59.0
12	68	4,640,000	6,800	.....	.....	3	8.0	26.0	63.0
	70	4,210,000	7,400	.....	.....	3	6.0	21.0	64.0
13	60	4,100,000	10,000	3.0	.....	2	6.0	23.0	66.0
	64	4,230,000	7,000	1.0	.....	2	4.0	30.0	63.0

*The upper figure in each square shows the initial count and lower figure shows the final count. In most cases, the counts were several months apart.

stated: Some patients with active gingival infections are included in the group report and tend to "cover up" cases of the real chronic type. In these reports, the first figure of each case indicates the first count, and the second figure indicates the last count.

REPORT OF CASES

CASE 1.—The hemoglobin was 65-82 per cent. The red cells, numbered 3,840,000-

4,400,000; white cells, 8,800-7,400, with small lymphocytes, 28-22 per cent; and polymorphonuclears, 59-67 per cent. It will be observed that this patient ended the test with a blood picture very close to the average of health. There was a corresponding improvement in the general condition of the patient.

CASE 2.—The hemoglobin was 50-70 per cent. The red cells numbered 3,740,000-4,000,000; white cells, 8,200-8,400; with small lymphocytes, 27.5-25 per cent, and polymorphonuclears, 58.5-65 per cent. This patient had a valvular heart lesion with symptoms that would naturally go with decreased circulation. Marked improvement in general symptoms followed the removal of the pulpless tooth.

CASE 3.—The hemoglobin was 70-70 per cent. The red cells numbered 4,984,000-4,212,000; white cells, 12,200-7,200, with small lymphocytes, 28-23 per cent, and polymorphonuclears, 54-67 per cent. This change was in the interval between November and June. The patient had not responded to treatment as well as she should. Her physician advised the removal of the tonsils. After this was done, the blood picture was as follows; hemoglobin, 83 per cent; red cells, 4,560,000; white cells, 7,100; small lymphocytes 23 per cent; polymorphonuclears, 68 per cent. This was an outstanding case in the relief of symptoms after the removal of the pulpless teeth and the tonsils. Two years after the operation, the blood picture is about the same.

CASE 4.—The hemoglobin was 35-68 per cent. The red cells numbered 3,520,000-4,010,000; white cells, 7,800-6,800, with small lymphocytes, 31-22 per cent, and polymorphonuclears, 62-67 per cent. There was marked improvement in all general symptoms. The hemoglobin lacked just two points of doubling.

CASE 5.—The hemoglobin was 70-80 per cent. The red cells numbered 3,940,000-4,260,000; white cells, 7,000-7,200, with small lymphocytes, 25-24 per cent, and polymorphonuclears, 62-68 per cent.

CASE 6.—The hemoglobin was 65-77 per cent. The red cells numbered 5,060,000-4,916,000; white cells, 10,200-7,000, with small lymphocytes, 27-24 per cent, and polymorphonuclears, 61-67 per cent.

CASE 7.—The hemoglobin was 68-78 per cent. The red cells numbered 4,700,000-4,780,000; white cells, 8,800-8,000, with small lymphocytes, 26-19 per cent, and polymorphonuclears, 62-66 per cent.

CASE 8.—The hemoglobin was 54-64 per cent. The red cells numbered 3,820,000-4,210,000; white cells, 10,200-7,200, with small lymphocytes, 28-24 per cent; and polymorphonuclears, 60-68 per cent. This change occurred in eight weeks.

These individual cases are given from the group of forty-one as fairly representative of the changes that took place. Aside from Case 3, no foci of infection except teeth were removed. Without doubt, in some of these cases, other foci were present; but the object of the experiment was to determine what changes took place after the removal of pulpless teeth.

The suggestion is made that the individual control cases be compared with the individual cases in which an operation was performed, by referring to the tables when they are published.

SUMMARY

Not all patients having pulpless teeth show a blood picture typical of chronic infection.

If there is an acute infection present about the alveolar tissues, the picture may tend toward a mild acute type.

Patients who complain of the symptoms common to chronic infection, viz., lassitude, chilliness, nervousness and shortness of breath, usually show the chronic infection type of blood picture.

Patients in the above mentioned group show quite rapid return toward the average blood picture of health when the foci are removed.

A control group made up of patients who had blood counts made at approximately the same time as the group operated on showed practically no changes in the blood picture.

365 Ellis Avenue.

THE PORCELAIN JACKET CROWN*

By C. G. PARKER, D.D.S., Detroit, Mich.

IN coming before this Association, it is not so much with the hope that I can present anything new in the construction of the porcelain jacket crown. This work has been so thoroughly taught in our dental journals and in several books written on the subject that we have come to accept a thoroughly standardized method of tooth preparation and crown construction.

I cannot find that our leading teachers and porcelain workers differ in any material way as to how a vital tooth should be prepared to receive a jacket crown. We also all burnish a matrix and fuse our porcelain in much the same way.

It is now possible to use a textbook on this subject and follow through step by step the entire procedure from the start of the preparation to the finished crown with each step shown by excellent photographs and elaborate explanations which any operator in this audience could follow through to a successful conclusion; if not the first time, at least after a reasonable amount of practice and careful application.

However, it has always been a source of wonder to those who have used porcelain extensively in their practices that it was not used much more by the vast majority of the dental profession, all of whom are capable operators and could master the art of fusing porcelain with no more effort and care than it took them to master the technic of the gold inlay.

I believe that there are two reasons why the porcelain jacket crown is not employed where indicated by many very good operators: (1) because of the belief that the preparation of the tooth and the fusing of the jacket crown is much more difficult than it really is, and (2) because of the failures that we have experienced in our first cases, which were more or less experimental, and undertaken without adequate study and painstaking preparation. Without doubt, many of us experienced difficulties and failures with our first gold inlays. We had ill fitting margins, failures in casting, poor cavity preparations, loss of anatomic restorations, loosened inlays, etc. Still we did not give up in despair and decide that the inlay was not practical; rather, we persisted in our efforts to perfect our technic and have constantly improved it for the past many years, realizing that the gold inlay is indispensable in our practices and has come to stay. Now, let us employ the same procedure in porcelain work and we may reasonably expect the same satisfactory results. Beyond a doubt, the men who aim to give to their patients the best service must become thorough masters of the art of fusing porcelain, and the porcelain

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jacket crown should now be as indispensable to the practice of dentistry as is the gold inlay.

Without fear of contradiction, I state my belief that the porcelain jacket crown most nearly approximates the ideal restoration where any considerable tooth structure is lost, and can be employed in the great majority of cases on any tooth in the mouth with the possible exception of the third molars, and I recently saw that tooth restored with a porcelain jacket crown, and the results were most satisfactory.

It is the belief of the porcelain jacket crown section of the Detroit Dental Clinic Club that any of the six anterior teeth where decay has involved the incisal angles or the mesial or distal to such an extent as to undermine dangerously the incisal edge is a subject for the porcelain jacket crowns. Bicuspids are always subjects for the porcelain jacket crown when decay is extensive enough to require a crown and individual restorations are indicated. I intend to show in my clinic that porcelain jacket crowns may be employed in a great many cases in which the teeth are to be utilized as abutments for bridgework both fixed and removable.

I recently saw in the office of Walter Hine in Hollywood, Calif., several pieces of Chayes' removable bridges in which porcelain jacket crowns on molars and bicuspids were utilized as abutments, and the results were most gratifying.

I also will show the use of the so-called thimble crown, where centrals and cuspids are to be utilized as bridge abutments and bicuspids and molars used in cast clasp cases. It would seem to me that the advantages to be gained in the latter type of work should remove the chief objection to its use: the danger of softening and resultant decay beneath the clasps.

Quoting from some of the men who are recognized authorities in the field of porcelain in dentistry, we find that LeGro in "Ceramics in Dentistry" says:

> The strongest claim that is made for jacket crowns is that they preserve the vitality and health of the individual tooth. They do more than that, they practically preclude any further decay or trouble when properly conceived and executed. There is perhaps no restoration used in dentistry today for vital teeth that can show such an unbroken record of success over a period of many years.

Again Dr. LeGro[1] says:

> In the employment of the jacket crown in restoring any individual tooth, porcelain reaches its greatest height and perhaps surpasses any restorative feature now employed in dentistry. Time has convinced the most skeptical, and it is now recognized that restoring the entire enamel area on a properly prepared tooth is a procedure that retains the vitality and health of a tooth for an indefinite time. In cavities of the incisors and cuspids involving both incisor angles and frequently only one angle in the average denture, the placing of a jacket crown is justified.
>
> In lateral incisors and first bicuspids, the teeth that are devitalized so readily, jacket crowns are particularly indicated, especially when the pulp is in danger from the technic used in the filling preparation. Molars and bicuspids are ideal teeth for jackets when the bite is not too short and sufficient dentine remains around the pulp to insure strength and protection.
>
> Wide shoulders in all cases are contraindicated. They are not necessary, and, when employed, often produce untoward conditions that are incompatible with the comfort and vitality of the pulp. Porcelain jackets on molars and bicuspids, unless correctly shaped and properly occluded, are not the equal of the average gold crown, but when proper contour, environment, type and anatomy are included, together with correct surface dimensions, porcelain jacket crowns are the peers of any other type now employed.

1. LeGro, A. L.: Porcelain: Indications and Contraindications, J. A. D. A., 14:1473 (Aug.) 1927.

Many teeth with large gold restorations eventually become devitalized, but under a porcelain jacket crown, this is rare, indeed; which most surely favors the employment of porcelain in the form of jackets.

Walter Hine says:

In the light of present day achievements, and modern consideration of correct manifestations of life, a pathologic condition of the soft structures surrounding a tooth or appliance is a discordant picture, and a contribution to the factors that endanger the life and vitality of a pulp is a tragedy.

Unfamiliarity with life principles that enable a pulp to perpetuate itself and remineralize the tooth to which it belongs may call for a review of physiologic chemistry and histology.

My opinion is that porcelain restorations set with metallic cements will assume a more nearly neutral position than any other cemented restoration.

Since we have the small, fast furnaces that will fuse the high fusing porcelains in 5-10 minutes, the model work becomes the most lengthy part of the work, and as we are obliged to use models for most all restorative operations, I cannot see why the porcelain jacket crown is not considered far more often than it is, most every one being cognizant of its pleasing effect esthetically and physiologically.

William Meier, New York City, says: "I consider the porcelain jacket crown not only the most beautiful and satisfactory restoration today, but it has all the qualities we are looking for; from a standpoint, first, of health, of service, and last but not least, of esthetics."

Let it be known that it requires no more skill to produce a good jacket crown than any other high grade restoration.

There are three operations in the fusing of porcelain that to many men seem to be so difficult to master as to discourage them in the extensive use of porcelain in their practices: first is the burnishing of the matrix; secondly, overcoming the shrinkage of the porcelain in fusing, and thirdly, the securing of such color in the finished crown as to defy detection. These points will be taken up later.

The jacket crown when properly made and carefully cemented not only preserves the vitality and health of the tooth, but also virtually precludes any possibility of decay in the future, and is accepted most kindly by the delicate gingival tissue. It approximates nature so closely as to defy detection under ordinary conditions. This, I contend, is the ideal restoration and I propose to convince you that to conceive and execute this artistic and desirable dental restoration presents no difficulties that cannot be overcome by any operator who is serious in his desire to succeed.

The history of the porcelain jacket crown is of the most absorbing interest, especially at this time and here in Detroit. It was in our own city that the porcelain jacket crown, now universally recognized as indispensable to good dentistry, was conceived and executed and given freely and without thought of pecuniary remuneration to the dental profession by two men known and respected throughout the whole dental world. One of these men, C. H. Land, has gone to his reward after fifty years of unstinted labor and devotion to our loved profession. The other, Edward B. Spalding, has attained an enviable place in the dental world.

Henry W. Gillett of New York City,[2] says: "Following the suggestion of Dr. C. H. Land, for a porcelain jacket crown, Dr. Edward B. Spalding of Detroit, has worked out a different technic for the crown which is so artistic in its final result, and so fascinating in the precision of the different steps of its development that it arouses immediate interest wherever shown."

2. Gillett, H. W.: Internat. Dent. J., 25: 362 (May) 1904.

Most of you are probably familiar with the article by Dr. Land[3] on "Porcelain Dental Art," in which he describes a porcelain crown similar to the one I will show you tonight. Dr. Spalding wishes to give credit to Dr. Land for the original suggestion of such a crown. The development of the technic of the crown is entirely Dr. Spalding's work and seems to me a distinct advance over Dr. Land's.

It is most interesting to know that the technic worked out twenty-three or more years ago for the preparation of the tooth to receive a porcelain jacket crown is still the proper procedure and has not been improved on to this day. This, I consider, shows a most remarkable vision and ability in a field in which Dr. Spalding was a pioneer.

With the advent of the indirect method and the use of amalgam models and conductive and infiltration methods by which we render the tooth insensible to pain, the work of preparing a tooth and constructing a crown should be infinitely easier for both operator and patient.

Dr. Spalding[4] has a most interesting article under the title, "Replacing the Entire Natural Enamel with Porcelain," published in 1904. His opening statement is just as true today: "Probably no one process has ever exerted so beneficial an influence over all branches of dentistry as the work with Porcelain is doing today."

While the profession as a whole has not yet become acquainted with it, the more progressive men are fast realizing the desirable possibilities of porcelain and the improved facilities for its use, and they are rapidly taking it up and acquiring skill in its manipulation. The infinite care which porcelain requires of an operator, in order that he may succeed in its various uses, soon becomes a habit, which he carries into his other work, where he may have been less careful before. His renewed interest in his work is noticed by other men in the profession, and they are filled with a sense of unrest and a feeling that there is something that they are lacking. Ere long they, too, are fascinated with the subject of porcelain, and the necessity for care in its manipulation increases interest in their work.

At this time of enthusiasm for porcelain, its workers and advocates are not confining their efforts to the simple inlays and the ordinary porcelain crown construction on a post and band of platinum, but are venturing into more extended and complicated uses in restoring lost tooth structure with this best of all materials. Sometimes, their efforts are attended with failure and regret, yet often with success, which repays them for their disappointments, and convinces them that the principles involved in the proper handling and fusing of porcelain are not so mysterious that they cannot be mastered.

In February, 1903, Dr. Land showed me what seemed at first glance to be an extracted central incisor, with the enamel detached from the dentin in one complete shell, but which, on second inspection, proved to be a shell of porcelain reproducing the natural enamel. It truly was the prettiest thing that I had ever seen in dental porcelain, and Dr. Land refers to the process in his article published in June and August, 1903.[5] At first, I had no faith in the durability of

3. Land, C. H.: Dent. Cosmos, 45:615 (Aug.) 1903.

4. Spalding, E. B.: Dent. Items Int., 26:401 (June) 1904.

5. Land, C. H.: Dent. Cosmos, 45:437 (June) 1903; Footnote 3.

such a thin shell of porcelain for actual use in the mouth; but the beauty of the thing led me to experiment on extracted teeth, and, after cementing several on models and finding what severe tests they would stand, I decided to put them to practical use in the mouth, and since May, 1903, I have used no other method for crowning incisors and cuspids where there remained sufficient dentin. I have also used the method on many molars and bicuspids.

The following process in detail for preparing the tooth, forming matrix, adapting veneer and fusing, I have adopted after considerable experiment and practice as being the most simple, direct and accurate means of producing a uniformly successful result.

The article goes on to describe the preparation of the tooth to receive the crown, and except for the use of an anesthetic, which was unknown at that time, might be followed today without change.

At that time, the matrix was made by cutting and folding the platinum in the shape of a cone, soldering the joint with pure gold and burnishing entirely in the mouth. I followed this method for many years, and while it is much more difficult than our present method of burnishing over an amalgam model, I obtained some very gratifying results. I then selected a vulcanite pin tooth of suitable shape and shade, and proceeded to cut out the lingual surface with stones until only the thin labial surface was left, and by a difficult process frought with many chances of failure, I waxed this in its proper place in the mouth, removed it and fused porcelain around the matrix, filling in carefully and building up the lingual surface until the finished crown was obtained.

The porcelain was obtained by crushing diatoric teeth to a fine powder by the use of mortar and pestle.

C. C. Bastain, New York City, says:[6]

The porcelain jacket crown is indicated in many of those cases where formerly the gold shell crown, the Richmond crown or the dowel crown was used. It is particularly useful, moreover, for teeth with vital pulps, for cases opening the bite, for peg laterals and for other restorations where it is impossible to get an ideal esthetic result with inlays, silicate cements, etc.

There are probably few if any restorations in our practice that give as much satisfaction to both patient and operator as the porcelain jacket crown.

Hugh Avary says: "The pulp under a properly placed and designed porcelain jacket crown may show no difference in health over a period of a decade or more and, furthermore, the pulp of such a tooth may pass through the same physiologic metamorphosis as those of adjacent teeth that are perfectly normal."

W. D. Vehe says:[7]

The cases in which porcelain jacket crowns are indicated, are, primarily, malformed teeth, malformed through some hereditary influence possibly, or through some condition of malnutrition, but still having vital pulps. These teeth are unsightly and many times are tender or decayed, and they can be restored beautifully in this manner. Teeth that have had a portion of the crown destroyed through decay, accident or otherwise, or teeth that through abrasion must be lengthened in cases where the bite is to be opened and still have vital pulps can be restored most generally. It is but seldom that an insufficient amount of structure remains with the pulp still intact. So you can see that in cases where the pulp remains vital the porcelain jacket crown should be first choice; and we will not confine it to anterior teeth alone, but to the ten anterior teeth and further if for esthetic reasons we see that it is indicated.

6. Bastian, C. C.: Dent. Cosmos, 65:1285 (Dec.) 1923.

7. Vehe, W. D.: Dent. Summary, 40:89 (Feb.) 1920.

C. W. Hoffer[8] says:

The porcelain jacket crown has been given to the profession with the idea of inspiring better work. It has given us a crown nearest reaching the point of perfection. It has more and greater advantages both to the dentist and the patient than any previously known crown, yet it has its disadvantages, but they are to be discussed as points contra-indicating a porcelain jacket crown. With the porcelain jacket crown, you are given the greatest advantage of the use of a crown in the anterior part of the mouth, giving your patient the finished tooth, having an esthetic value never before known—its contour, its size and color even to the developmental lines, white spots and any other formation peculiar to that one mouth reproduced in every detail. Its esthetic value, not only in anterior parts of the mouth, but in posterior parts as well, is an advantage not to be surpassed.

As a crown reaching nearest the point of perfection, the greatest advantage is in an ability to secure a union of crown and tooth that is free from overhanging margins, free from failure to fit the other depressions and other irregularities so frequently found at the necks of teeth. Therefore, with the porcelain jacket crown, we are able to insert a crown that will meet with the demand of our prophylactic men in the way that we give them a mouth free from irritating non-fitting margins, and a crowned tooth that they can carry into effect their curetting of pockets and polishing of the necks of teeth without being troubled with the obstacles we all know they find in such work around teeth carrying other kinds of crowns. . . .

. . . Anterior teeth deeply decayed with angles either broken away or too weak to retain fillings . . . cannot be filled or inlayed; they do not offer body enough to retain either; therefore, you are confronted with the problem of devitalization and inserting a crown with pin. With the porcelain jacket crown you can save the pulp and give the patient a more natural tooth in appearance and one that gives the hygienic qualities above mentioned. . . .

Porcelain jacket crowns as abutments for removable bridges are ideal where clasps are to be used as they overcome all its bad features; *first,* you can shape them properly for the retention of the clasp; they also allow for paralleling for multiple abutments, the porcelain being sufficiently hard to withstand the wear of the clasp, and the strength of a porcelain jacket crowned tooth is great enough to endure all additional weight employed and more than should be carried by any one tooth, in the case of an abutment.

With this technic you eliminate . . . caries due to fermentation under the clasps.

When we have determined that a certain tooth can best be restored to its original usefulness and beauty by means of a jacket crown, it is well to secure a roentgenogram that will show us the size and extent of the pulp chamber in order that we may not encroach too close on the horns of the pulp.

In most cases, it is best to use some harmless anesthetic, preferably procain, either by infiltration or conduction. The comfort and quietness of the patient will make it much easier for the operator to accomplish the delicate work, especially the forming of the shoulder. The first cut is to reduce the incisal at right angles to the force of the opposing teeth enough to give sufficient bulk of porcelain to withstand strain without encroaching too much on the pulp chamber as indicated in the roentgenogram.

Then the mesial and distal surfaces are removed with a safesided disk with one straight clean cut from the incisal to just beneath the free margain of the gums, the cuts tapering toward the incisal. Next, the labial and lingual surfaces are removed with small mounted stones until all the convexity has been removed. At this point, a measurement is taken and a copper band approximately twice the length of the crown of the tooth is made and carefully festooned to slip evenly beneath the free margin of the gum to a depth of 2 mm. The band is pinched labiolingually until it is oval in shape at the incisal end and touches the crown of the tooth on either side,

8. Hoffer, C. W.: Dent. Summary, 41:1030 (Dec.) 1921.

which makes it possible to guide the band accurately to place when the impression is taken. The labial surface is then marked by scratching a cross and the band is laid away for future use.

We now complete the preparation by removing the remaining enamel with cross-cut fissure burs and mounted stones, being careful not to heat the tooth. A constant stream of water at body temperature is used in cutting with stones, since the tooth has been anesthetized and the patient may not protest even though the tooth should be burned by friction sufficiently to cause the injury or death of the pulp. The formation of the shoulder 1 mm. beneath the free margin of the gum is best accomplished by the use, first, of small sized straight sided mounted stones, which reduces the crown to the required size without producing uneven or jagged cuts, undercuts or unnecessarily deep cuts, such as might be produced with a bur.

The shoulder is only started and outlined with the small stones, care being taken not to cut or in any way injure the delicate gum tissue at the cervix as injury to this structure frequently results in retraction or destruction and consequent ultimate exposure of the joint, which renders the work unsightly and unsatisfactory. To finish the shoulder, finally, the most accurately and carefully prepared step in the entire operation as far as we have gone, I have found the use of a magnifying glass to be indispensable. Hancock's "Eagle eyes" are most useful.

As far as I am aware, the following procedure, which has worked out most successfully in my practice, is original. At this point, a compressed air blast is used by the assistant to lift carefully from the neck of the tooth the delicate free margin of the gum, while the operator, using the magnifying eyes and sharp end cutting burs, forms a smooth evenly cut shoulder 1.5 mm. below the gum line, completely surrounding the tooth except in certain cases which I will explain. The use of the air blast accomplishes four things that are of great assistance to the operator in the delicate work of preparing the shoulder, which must be without nicks or cuts caused by the bur slipping or the field being obscured by either moisture or blood.

First, the air blast gently lifts the free margin of the gum from the neck of the tooth, removing the chips instantly from the field, preventing moisture either from saliva or the weeping of the gum tissue and keeping the tooth from becoming heated or burned by the use of the bur or stone, which we run dry.

When the shoulder has been completed, the crown of the tooth is carefully polished with fine cuttle fish disks, removing all traces of undercuts and rounding all sharp corners and angles. This also is done under the air blast, the operator always keeping in mind that the nerve is quietly sleeping under the anesthetic and the delicate organ will not protest even though we should carelessly burn it and cause serious injury, if not its ultimate death.

The next step is to secure the impression and model. We now take the copper band, which has been carefully fitted and laid away, and fill it with black impression tray compound. I have found this most excellent for the purpose as it gives a sharp impression and sets very hard. Before the impression is taken, oiling the tooth with melted cocoa butter helps greatly to reduce shock and facilitate the removal of the impression.

A small glass jar of cocoa butter is set in the sterilizer and boiled for five

minutes. Then the assistant carefully oils the tooth or teeth while the operator is warming the compound in the copper band preparatory to taking the impression. The band is carried from 1 to 2 mm. beyond the shoulder, the operator making sure that it is in proper position. It is then held firmly under pressure while it is chilled with cold water and then removed under the "eagle eyes," the modeling compound being carefully turned back above the shoulder, which would tend to cause a restriction in the size of the model at the neck of the tooth and render it difficult to remove the matrix after it has been swaged. The model is now sunk and packed with amalgam. Use of the packing vise made by Garhart will greatly aid in securing dense, evenly packed models,[6] which are essential to the success of this work.

When the model has set, preferably overnight, we remove it from the plaster, carefully polish the shank with disks and cut a step in the end of it, which will enable us to seat the minor model accurately in the major model as many times as we wish, with assurance that it will go to place definitely each time.

The next important step is the construction of the matrix. Many operators have delayed taking up porcelain work, both inlays and jacket crowns, because they imagined that the matrix technic was too difficult and required too much time.

The different steps in the construction are comparatively simple and, when followed through in their logical sequence, present no great difficulties and require no great amount of skill. In order to facilitate the chances of success, a piece of platinum foil of generous size should be selected. To attempt to use a piece of foil cut too closely to size, or first to make a pattern of some other material, such as tin foil, from which to cut a piece of platinum, almost always invites failure and consumes more time and nervous energy than the saving effected can possibly amount to.

The surface on the minor model best suited to care for the fold or tinner's joint that we are to make in the platinum is selected. On anterior teeth, this will usually be on the lingual side. The platinum is placed against the opposite side of the model, being pressed firmly against the model so that it will lie there smoothly and be firmly held in place. Two parallel cuts are made from the top of the platinum to each approximo-incisal angle; which will provide an incisal flap that may be folded down to cover the incisal portion of the model smoothly and without unnecessary bulk of platinum. With a heavy pair of foil pliers, the two wings of the platinum are brought together as snugly as possible on the lingual surface of the model preparatory to the making of the tinner's joint, which will be described later.

At this point, we proceed to outline the shoulder, burnishing the platinum carefully and smoothly to the model, using an orangewood stick that has been sharpened to a chisel edge, either with a stone on the laboratory lathe or with coarse carborundum disks and the dental engine. When the shoulder has been definitely outlined, we trim the platinum wings as closely as possible, allowing only sufficient overlap to make a neat and smooth tinner's joint, which is made by folding the platinum twice in the same direction and carefully ironing it down against the model. This fold can best be made by using a pair of long beak pliers with straight edges, and a much neater and closer joint can be made by using the magnifying bows. When the joint has been completed and

carefully ironed down, we will find the platinum projecting above the incisal edge of the model to form a box, three sides of which are higher than the model, the fourth side being the incisal flap which has been folded over the incisal end of the model and is, therefore, not of excessive length. The other three sides we now trim to the same length as that of the model and then burnish down to a smooth and close adaptation. We now carefully remove the platinum matrix and trim the apron or part of the platinum extending below the shoulder evenly at right angles to the long axis of the model, thereby forming a firm, square base, which insures the matrix standing up evenly and firmly on the slab when introduced into the furnace. I advocate the use of carefully sharpened orangewood sticks exclusively in burnishing the platinum as the use of metal burnishers tends to make the platinum stiff and springy, which results in the matrix springing from the model and also renders the platinum more liable to crack or split. I believe also that a close adaptation of the matrix to the shoulder is much more essential than that the matrix be adapted absolutely to the crown portion of the model. Often, excessive burnishing of the matrix on the coronal portion of the model will render it stiff and springy and will result in springing of the platinum from the shoulder, which is often discovered only when the platinum has been stripped from the finished crown, too late to allow correction. Swaging of the matrix is entirely unnecessary, as is excessive burnishing. More attention should be given to securing a close adaptation to the shoulder than to any other part of the matrix. The matrix should disengage from the model easily and without distortion.

The next step is an accurate impression, which can easily be secured by following a few definite steps in their logical sequence. A small amount of sticky wax is melted on the end of the seating jacket and impression compound is placed in the bridge tray, the tray being chilled in cold water in order to render the base of the impression compound stiff and resistant of pressure. The surface is warmed and the tray passed firmly to place, carrying the seating jacket firmly to its seat. The impression is chilled and removed and the minor model is placed in the seating jacket. The model is then poured in "snow white No. 1" and an opposing model made and articulated. Now comes the building up and fusing of the crown, which perhaps seems to present more difficulties than any other part of the construction of the porcelain jacket crown. The first two fuses are made primarily to insure that our matrix shall not suffer distortion, and can be easily handled when we come to build up the bulk of the crown and secure proper approximal contact and proper occlusion. These first two fuses are quickly and easily made and, when, they are completed, it is much easier to visualize the finished crown and we feel that we are well on our way. We first coat the matrix with a mix of porcelain, using the basic color that we have selected for that case, and distributing the porcelain evenly over the entire matrix down to, but not touching, the shoulder. The vibration of the model should carry the mix to the right angle bend in the platinum, and here it should be trimmed with a very sharp spatula to end evenly at the angle and not spread upon the shoulder, which is brushed clean and entirely free of particles of porcelain with a small brush the bristles of which have been cut off

squarely and are about 4 mm. in length. We are now ready for the first fusing. The porcelain is brought to a biscuit bake, removed from the furnace and carefully forced back on the model. With a sharp orangewood stick, we carefully burnish the shoulder, which is easily done as the platinum has been thoroughly annealed by the first fusing and will lie soft and dead against the model, provided we do not use metal instruments or indulge in excessive burnishing. We now fill in the triangular space made by the shoulder, packing the porcelain both by vibrating and by tapping with a smooth, flat burnisher against the shoulder, always keeping in mind that porcelain will shrink towards its greatest bulk, that fusing is solely for the purpose of establishing the shoulder and we, therefore, fuse directly upon it and avoid any tendency of the porcelain either to draw away from the platinum or to lift the platinum from the shoulder of the model. With the two fusings successfully accomplished, we are ready to build and carve the crown, with the assurance that no distortion of the matrix will take place and that, when the platinum is stripped from the finished crown, we will have a close fitting shoulder of densely fused porcelain.

As to building up the crown and restoring tooth anatomy and shade, only careful study and painstaking practice will make for success.

In at least 95 per cent of normal teeth only one color is found and that is yellow in its varying shades. The color problem need not be difficult when we realize that nearly every tooth that we are called on to match contains only this one color, and its density or absence determines the shade. We realize that color work is not impossible to any of us unless we are suffering from color blindness.

Unusual markings and colorings can always be reproduced by grinding and staining the porcelain, and the degree of perfection is limited only by the skill and patience of the operator.

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DISCUSSION

E. B. Spalding, Birmingham, Mich.: Dr. Parker's paper adds another block to the solid foundation on which the porcelain jacket crown is built. He has not only given his own excellent argument for the sure and necessary place the crown should occupy, but has also brought to our attention what other dentists working for years with porcelain, have found to be true: that the use of the porcelain jacket crown is the best of all known operative methods for preserving the life and health of the dentin and pulp of the individual tooth which has defective enamel from any cause. I remember that when I was demonstrating the porcelain jacket crown in New York City, Dec. 8, 1903, one of the prominent dentists of that city said, "Why do you leave the pulp alive? Why do you not devitalize and fill the canal in the first place? It will die anyway, it will be smothered." I replied that while there was only several months of experience on which to base an opinion, I believed that the pulp would not become irritated or infected unless it had been exposed in the preparation or infected from caries before it was prepared; that the case was not similar to crowning a tooth with gold, which continually shocks the dentin and pulp with thermal changes, and that a tooth is more comfortable under porcelain than under any other material, except its own enamel. After twenty-four years, I can repeat that statement with certainty and assurance. The fingers on one hand are sufficient to count the pulps I have found dead under porcelain jacket crowns. That a few were found dead is explained by the presence of deep caries in a cavity before the tooth was crowned, or exposure of a horn of a pulp in a young tooth, because the tooth was rotated and the preparation was made to put on a crown in a straight or normal position in the arch. These cases cannot be blamed on the crown.

The porcelain jacket crown needs no argument in its favor; its record speaks for it. I am sure that we all agree with Dr. Parker that the place of the porcelain jacket crown is in the practice of every progressive operating dentist. Dr. Parker has said that he cannot find that our leading teachers and porcelain workers differ in any material way as to how a vital tooth shall be prepared to receive a jacket crown. When we stop to consider that statement, we realize that there is probably no other important operative procedure on which there is such general agreement. Surely that cannot be said about cavity preparation for inlays. All the steps in the technic of constructing a jacket crown might be said to be standardized. There is no reason, then, why a dentist cannot learn the process of constructing a porcelain jacket crown if he wishes to do so. If preventive dentistry in its broadest sense means thoughtful, skilful dentistry, which has for its highest aim the utmost in preserving the tooth or teeth in question, the porcelain jacket crown is one of our best means of prevention in operative dentistry. It prevents shock, either thermal, electrical or chemical, to the dentin and pulp. It prevents irritation to the periodontium, assuming that the correct anatomic form is carried out in its construction, and it has the proper glaze. It prevents redecay of the dentin except where gross lack of care of the mouth has caused the gingiva to recede and expose the joint, and even then caries is not likely to take place. No need for metaphen as a preventive against *Bacillus acidophilus* about a tooth crowned with porcelain. When a tooth has one or more large fillings, as instanced by incisal angles of incisors, there may be frequent cause, arising through breakage or decay, to repair these teeth. At each time, there is more loss of dentin and enamel and the possibility of the pulp's being injured, even though not completely exposed. The employment of a jacket crown would prevent this loss of dentin toward the pulp. It would prevent loss of time to the dentist, and loss of time and expense to the patient. The more extensively the jacket crown is substituted for large inlays, especially gold, the less extensively will root canal surgery need to be practiced and the fewer will be the number of devitalized teeth to be extracted. It takes less skill to prepare a tooth and make a porcelain jacket crown than it does to prepare a complicated cavity and make a porcelain inlay. The inlay requires more delicate manipulation and finer application of colors and light effects. The gum covering the joint of a crown may cover a multitude of sins, but the joint of a porcelain inlay is held up to strong light for inspection. This is no argument for carelessness in making the joint of a crown. In the writings on the porcelain jacket crown, the authors dwell at great length on the technic of construction, but the real art of reproducing nature's work is usually touched on only in a general way; probably because "art is long and time is fleeting." In reproducing a tooth in porcelain, color and shading are important, but they are second in importance to form. A porcelain crown may be considerably off shade, but if the form reproduces in detail the characteristics of the neighboring teeth, it is much less conspicuous than if the color and shading are correct and the form out of harmony with its neighbors. No two persons see the same colors in the sunset, and what each puts on the canvas depends on what is reflected in his soul and his ability to portray it with his brush. A man cannot view an Italian sunset and then write a letter about it so some one across the ocean and expect it to be accurately reproduced and awaiting him in a frame when he returns home. Let no dentist talk about art in porcelain who delegates his work to the commercial laboratory. He may fill his pockets with shekels, but not his soul with joy, if he has any artistic sense.

Albert Leland LeGro, Detroit, Mich.: Dr. Parker has called attention to the so-called thimble crown, a construction of porcelain depending on a gold base fitted accurately and covering a preparation, freshly and sometimes deeply, cut in vital dentin. I am inclined to think that, without a great deal of experience and a long line of clinical evidence as to the tolerance by the vital tooth of this all metal covering, it is a procedure that we should approach cautiously. For a number of years, I have made it a practice to remove the entire enamel area in preparing for jacket crown construction. Both by essay and lecture, I have taken every opportunity to impress the necessity of such a procedure. Time and observation have compelled me to change my mind. That as much enamel of the gingival anatomy as possible should be left is, I am now convinced, quite

necessary. Up to middle age, where there has been no recession of the gum and there is no reason to expect recession of the gum, it is best to refrain from removing the collar of enamel under the gum line and cut the shoulder in the enamel or enamel and dentin leaving the gingival anatony of the tooth intact. When the entire enamel is stripped, it becomes necessary to construct the porcelain jacket so that the gingival structures under the free margin of the gums faithfully portray in contour and dimension the enamel removed. I do not believe that any human being can faithfully accomplish that. The soft tissues surrounding the gingival structures are furnished by nature to conform to the particular shape and dimensions of the gingival structure and the natural shape and dimensions of this particular part of the enamel are, therefore, naturally best adapted to the tissue environment. Many Richmond crowns illustrated the point that I am attempting to make. In these cases, all of the enamel is stripped off and the end of the root is slightly beveled. A ferrule is fitted over the root end, and though it may be fitted without any possible irritation as far as adaptation is concerned, a recession within six months or a year is manifested, owing to a deficient portrayal of the gingival structure under the gums. I therefore, believe in the retention of this part of the enamel on vital teeth up to and through middle life, feeling, for reasons just mentioned, that the tooth will remain healthier for a greater time. The thimble crown, in order to be well made, necessitates the removal of the entire enamel area and much more of the dentin than it seems wise to remove. The tooth tissue will not tolerate gold as it does porcelain, and this added to the fact that more tooth destruction is necessary to accommodate both the gold thimble and porcelain makes it, in my mind, a hazardous procedure. Dr. Spalding has called attention to the fact that little care is generally taken of the tooth after preparation, that is, the time intervening between the preparation and the final cementation of the crown. Guttapercha is often rolled up to cover the preparation to protect it from thermal changes. In many cases in which guttapercha has been employed, there is irritation enough to cause permanent recession and in a short time show the shoulder line between the porcelain and root. There are ways to avoid this: Covers that are as carefully made as any other finished construction should be put on; the surface dehydrated, and the contents of the tubuli coagulated with phenol. One very thin coating of Callahan's rosin solution warmed is applied, followed by a coating of amyl acetate varnish or any good thick film varnish. The covering employed may then be any one of several, such as the silicate cements in tooth forms or paste of white oxid of zinc and eugenol, care being taken that the fit of the form is good at the cervix and no excess material is left under the gum line to cause irritation. I am convinced that the thinnest of porcelain consistent with good engineering makes the best and strongest crowns if the porcelain is evenly distributed; i. e., a narrow uniform shoulder affords the best results. Dr. Parker has given us a valuable résumé in chronological order.

Dr. Parker (closing): The thimble crown that Dr. LeGro has spoken of I am not advocating promiscuously, except in very favorable cases, such as in a cuspid tooth where the lateral is missing, a condition which we often meet in practice. This cuspid tooth is prepared just as for the ordinary jacket crown. We use thirty-two gage wax, laying it around the model. Then we cast the thimble of hard gold. We have no gold line at the joint. That we must avoid. We must have porcelain only in contact with the gingiva. The thimble does not cover the shoulder. When the porcelain crown is finished, it fits the shoulder exactly as if the gold jacket were not there. The gold is not brought on to the shoulder at all. It finishes just at the angle or joint. We put the thimble back on the model and fuse the jacket crown as if that were the original model, burnish the platinum matrix over that and complete the fusing of the jacket crown, with no idea that we are going to use this thimble for anything. There is one point where the gold must come through and that is all; that is just at the point where we are going to solder the proximal point of contact. After the jacket crown is entirely completed as any porcelain jacket crown would be completed, we put it back on the model and we pencil on the crown just where we wish to cut out this piece of porcelain and attach the gold. We then take a sharp stone and cut a U-shaped piece from the porcelain crown just exactly where we wish it to come

on the point of contact. We then place the jacket crown back on the model and, with inlay wax, make a pattern to replace the porcelain that was cut out. We take it off and cast it, put it back in place, remove the porcelain jacket crown, attach the gold casting with a tiny particle of wax, then solder with minute particles of 22 solder, and place it back on the model. In that way, we preserve our porcelain contact with the gingiva over the entire surface except at one point on the mesial surface where it approximates.

THE CAUSES OF VARIATION IN SALIVARY CALCIUM; THEIR RELATION TO SUSCEPTIBILITY AND IMMUNITY TO DENTAL CARIES*

By HAROLD J. LEONARD, B. A., D. D. S. New York City

THIS paper is a report of progress on research work undertaken two years ago but which has by no means yielded, up to this time, such definite information as was hoped for or as the title of this paper might indicate. The problem was undertaken because it seemed to be the only promising chemical lead not yet thoroughly explored to the solution of the problem of susceptibility to dental caries and because what work had been reported on it up to the time of commencing the research, namely that of Bunting and Rickert,[1] indicated a definite correlation between the amounts of salivary calcium and immunity to dental caries.

According to the findings of these workers, those persons who are apparently immune to dental caries show a salivary calcium content of 2.5 mg. or more of calcium oxid to 25 c.c. of saliva or, in the usual terms, 7.1 mg. of pure calcium in 100 c.c. of saliva; while evidently susceptible individuals will show a salivary calcium content of saliva of 6 mg. or less per hundred cubic centimeters. They showed that variations in salivary calcium were apparently not related to those in the blood since the calcium in the blood remains rather constant around 10 mg. per hundred cubic centimeters, while that in the saliva will vary from 3.4 to 11.4 mg. They showed also that calcium in the saliva could not be increased by feeding calcium in large amounts either with or without phosphates. Furthermore, they demonstrated that those individuals having heavy deposits of salivary calculus do not have the higher concentrations of calcium in saliva, none showing more than 8.5 mg. per hundred cubic centimeters.

These figures of Bunting and Rickert are unfortunately open to much doubt because of the technical method of calcium analysis used. They used the Kramer-Tisdall method consisting of

*Work done at Marquette University Dental School.

*Read before the Section on Histology, Physiology, Pathology, Bacteriology and Chemistry (Research) at the Sixty-Ninth Annual Session of the American Dental Association, Detroit, Mich., Oct. 26, 1927.

1. Bunting, R. W., and Rickert, U. G.: Dental Caries, J. N. D. A., 2: 252-258 (Aug.) 1915; ibid., 4: 82-96 (Jan.) 1917; Rickert, U. G., and Palmerlee, Faith: Comparative Study of Total Salivary and Blood Calcium in Varying Types of Individuals with Special Reference to Cases of Pregnancy. II. Focal Infection, J. A. D. A., 11: 783-789 (Sept.) 1924.

ashing a 25 c.c. sample of saliva in a platinum crucible, taking up with acetic acid, precipitating as oxalate, filtering, washing, and weighing as calcium oxid ash. This method is satisfactory where larger amounts of calcium are analyzed, but it is quite inaccurate for such small amounts because of the solubility of calcium oxalate in the water used to wash it. The solubility of calcium oxalate is from 0.7 to 0.8 in 100 c.c. of water at ordinary room temperature. This means 0.25 mg. of calcium. With ordinary washing, this might easily make an error of 0.5 mg., which might be over 25 per cent of the total. Dr. Bunting mentions the fact that the figures are lower the second year than the first, perhaps owing to different technicians. Neither Dr. Bunting nor Dr. Rickert speaks of controlling their method by analyzing known concentrations of solutions having similar amounts of calcium to those found in samples of saliva. Since the difference between the amounts of calcium in the saliva of the immune and that of the susceptible is, according to their figures, very slight, approximately 1 mg. in 100 c.c. of saliva, and the error in the method might easily be more than that amount, it is fair to withhold judgment on their deductions pending further work.

In 1924, Spencer-Payne[2] gave the result of a series of calcium analyses of saliva, estimating the calcium by the Laidlaw colorimetric method. He says that this method recently devised by Dr. Laidlaw[3] has revolutionized the estimation of small amounts of calcium, it being possible to estimate with accuracy to 0.002 mg. This statement can scarcely be credited by one who has done much work on the analyzing of very small amounts of calcium. It is more complicated and has more steps than the usual permanganate titration method and it includes all the steps of precipitating the calcium as oxalate, separating and washing, in which the greatest errors occur. No method for the analysis of such small amounts of calcium has yet been devised which has proved to have better than a maximum error of + or — 2 per cent.

His findings in regard to calcium in saliva in relation to susceptibility and immunity did not confirm those obtained by Bunting and Rickert.

He says, "Indeed the calcium content seemed to vary not only with the individual but also from day to day, and indeed at different periods of the day just as the chemical reaction varies. Furthermore, there was certainly no clear relation between the amount of calcium and the liability to caries."

Broderick,[4] in 1920, stated that he found the calcium index low in patients with fever and was able to raise it by administering properly combined extracts of the endocrine glands. His method of calcium estimation, namely that of Blair-Bell, consists of precipitating the calcium as oxalate and counting the crystals in a hemocytometer. Since the size of calcium oxalate crystals is so difficult to control, this method of determination, and deductions made from it, seem to offer little of scientific value.

In the last few months, Clark and Levine[5] and Clark and Shell[6] have re-

2. Spencer-Payne, A. L.: Brit. Dent. J., 45: 1637 (Dec. 15) 1924.

3. Laidlaw, P. P., and Payne, W. W.: Biochem. J., 16: 494-498, 1922.

4. Broderick, F. W.: Brit. Dent. J., 41: 955 (Oct. 15) 1920.

5. Clark, G. W., and Levine, Lena: Am. J. Physiol., 81: 264-275 (July) 1927.

6. Clark, G. W., and Shell, J. S.: Dent. Cosmos, 69: 500-513 (May) 1927; 69: 605-617 (June) 1927.

ported work done at the University of California on the inorganic constituents of saliva. Their method of calcium analysis is essentially the same as that finally adopted independently in the present research. It will be described later. They showed that the calcium does not vary as the ash and phosphorus content vary, but that it remains much the most constant of all salivary constituents. The analysis of a series of daily specimens of saliva obtained in the morning showed the calcium to be uniform, but specimens taken in the afternoon showed variations as great as 40 per cent. Wide variations appeared in weekly values in the same person, from 4.6 mg. per hundred cubic centimeters one week to 10.8 mg. another week in one subject, and from 4.8 to 11 in another subject. Resting and activated specimens of saliva are subject to the same degrees of variation. Saliva activated by chewing paraffin, taken immediately after obtaining resting saliva, sometimes showed a greater calcium content, sometimes a lesser, but at no time a variation of more than 1 mg. per hundred cubic centimeters. They find much greater variation in saliva taken from hour to hour on a fasting day than in that taken on a normal day. They show no correlation between the amount of calcium ingested and that appearing in the saliva. They believe the calcium and phosphorus are combined with mucin because of the difficulty of separating out mucin that is free of calcium and phosphorus and because of the slowness with which calcium is precipitated as oxalate out of saliva. They are sure that the phosphorus is all in inorganic form. They assert that, at present, there is no available method for determining accurately the calcium ions in biologic fluids.

These authors apparently made no attempt to study a relationship between susceptibility and immunity to dental caries and the calcium amounts in the saliva. Unless we are to believe that the subject varies from week to week in his susceptibility, it would be hard to perceive such a relationship in any of the subjects for which these authors ran a series of calcium determinations, no matter what a clinical examination of the mouths might have shown as to progressive caries. Their tables and work show variations in salivary calcium to be unrelated to variations in blood calcium, to diet, or to calcium ingestion; to be unrelated to variations in other constituents of the saliva, and to whether the saliva is resting or activated by chewing paraffin. Certainly, if the same subject on a constant diet will show salivary calcium of 6.1 mg. per hundred cubic centimeters one week and 11 mg. the next, as shown in one subject in their tables, it is fair to assume that the mere determination of salivary calcium at any one time cannot be used as an index of possible susceptibility and immunity to dental caries.

If the work of Clark and his associates had come to my attention a little earlier, this paper would not have been presented, for the work and results are simply a partial duplication and confirmation of their work.

At the beginning of the present research, the method of calcium analysis used by Bunting and Rickert was employed, since the problem was an experiment in calcium determinations, not one in technical methods. But at the first attempt at controls, by running duplicate samples of saliva, such wide discrepancies appeared that it became necessary to check up on the methods. It was found that so much calcium oxalate was

dissolved out in washing the precipitate on a filter paper that great errors occurred. The loss of 0.5 mg. out of a gram of calcium, is not great, but such a loss out of 1 mg., as there may be 25 c.c. of saliva, is tremendous. A search for a method which would give accurate results was therefore the first problem. The microdetermination used for blood cannot be employed entirely because of the presence in saliva of mucin which can neither be filtered nor centrifuged off, nor completely destroyed, except by ashing.

The method finally adopted consisted of a modification of the Clark-Collip[7] method of determining calcium in blood serum. The saliva is obtained by chewing paraffin and expectorating into a graduated 8 ounce bottle until 25 c.c. of saliva is obtained. After cooling to room temperature, exactly 10 c.c. is delivered from a calibrated pipet into a clean 25 c.c. platinum crucible. This is placed over a water bath until thoroughly dry, then ignited over a Bunsen burner carefully, to avoid spattering, until the carbon completely disappears. Three cubic centimeters of 3 per cent hydrochloric acid is added in small portions delivered from a 1 c.c. pipet, each portion being taken up by another 1 c.c. pipet and used to wash the inside of the crucible completely. The successive portions are delivered to a clean 15 c.c. pyrex centrifuge tube which is tapered at the bottom to a point where it measures from 6 to 7 mm. outside diameter at the level where it contains 0.1 c.c. After delivering the ashings from the crucible, approximately 0.5 c.c. of water is run through the pipet into the centrifuge tube to remove any traces of ash. A drop of bromphenol blue is added to the solution in the centrifuge tube, then 5 per cent ammonia, drop by drop, this being mixed thoroughly by rotating the tube and heating slightly, if necessary, to the point where the color changes from yellow to blue or lavender. Five cubic centimeters of 4 per cent ammonium oxalate is added. The mixture is heated on a water bath one-half hour, allowed to stand one-half hour until cool, and then centrifuged five minutes at 1,500 revolutions a minute. It is decanted carefully and the tube, still inverted on absorbent paper, is placed in a rack for five minutes. The drops clinging to the mouth of the tube are wiped out with a clean soft cloth. Approximately 3 c.c. of 0.56 per cent ammonia is used to wash down the sides of the tube, being delivered from a wash bottle with a fine tip. The tube is placed in a hot water bath for fifteen minutes, cooled to room temperature and centrifuged. It is drained and the mouth of the tube wiped again in the same way as before. Five cubic centimeters of normal sulphuric acid is added and the mixture is heated to approximately 70 C. and titrated with 0.01 normal potassium permanganate delivered from a 10 c.c. microburet to a definite pink color, which persists one minute. The pellet in the point of the tube may be dissolved easily in the sulphuric acid by the use of a fine stirring rod, which is also used to mix the permanganate with the solution of oxalate during the titration.

By this method, the loss of calcium by solution of calcium oxalate in the liquid from which it is precipitated and in the ammonia water used to wash it is almost exactly compensated for by traces of ammonium oxalate, which are not entirely removed by the one washing and the careful drainage used. Tests

7. Clark, E. P., and Collip, J. B.: J. Biol. Chem., 63: 461 (March) 1925.

with known solutions of calcium chlorid containing equivalent amounts of calcium to the 10 c.c. saliva samples show errors not exceeding + or — 2 per cent. The greatest difficulty with the method lies in the tendency of fine colloidal crystals of calcium oxalate to crawl up the sides of the tube at the time of washing with ammonia water and fail to be centrifuged out of the surface of the fluid. Heating fifteen minutes in a hot water bath increases the size of these crystals to the point where they no longer remain as a pellicle after centrifuging. The method is arbitrary and exacting, with pitfalls at every step, but, when mastered, is accurate to within the limits of experimental error and is fairly rapid.

The chief value of the present research up to this time is the development of this technic and checking up the various steps in it with controls. Porcelain and silicate crucibles were tried, but proved faulty because of the corrosive action of the alkaline phosphates on the silica. Platinum crucibles smaller than 25 c.c. have the disadvantage that, at the time of ashing, the fused ash tends to crawl over the edge of the crucible. The crucible must be washed and washings withdrawn by means of a pipet. Any technic involving pouring out washings with a stirring rod is almost sure to result in loss and also requires more wash water. The reaction point at which the calcium oxalate is precipitated must be exact. If too acid, the calcium or oxalate is not all precipitated. If too alkaline, some calcium is precipiated as hydroxid. The turning point of bromphenol blue is a hydrogen ion concentration of p_H 5.5, which is correct. Acetic acid, which has been recommended by Kramer and Tisdall as a good medium in which to make this precipitation, tends to cause too fine crystals to form so that centrifuging is difficult. Complete precipitation is effected in one-half hour of heating in a water bath and cooling to room temperature. Filtration requires too much wash water, so that much calcium oxalate is lost by it. The solubility of calcium oxalate in water and in 0.56 per cent ammonia at room temperatures had to be determined since the figures given by various authorities differed greatly. Calcium oxalate is found to be soluble in distilled water at room temperatures to the extent of 8 mg. in a liter; in 0.56 per cent ammonia, to the extent of 20 mg. in a liter.

Although a fairly large number of determinations were made, most of them were discarded, because of subsequently discovered errors in technic that made the results of doubtful value.

In all, sixteen determinations were made after the method was sufficiently controlled so that dependence could be placed on the results. These consisted, first, of a series taken from time to time on the same person, and, secondly, of a few examinations of samples of resting saliva coupled with samples of activated saliva obtained immediately afterward.

The first series showed similar variations to those shown in Clark and Shell's series. The calcium varied from time to time as follows: April 11, 11.8 mg. per hundred cubic centimeters of saliva; April 18, 8.6 mg.; April 25, a.m., 6.4 mg., p.m., 6.4 mg.; April 30, 6.0 mg.; June 10, 6.0 mg.; June 16, 11.2 mg.; June 20, 11.2 mg.; June 22, 8.4 mg.; July 26, 6.26 mg.; August 8, 6.29 mg.; August 11, 7.56 mg. The saliva was activated in each case by the chewing of paraffin. No relationship could be detected in these amounts to the state of well being, to the amount or type of food eaten for the previous three day

period, or to physical or mental work done the two days before. The patient was a man, aged 39, living a fairly intense intellectual life, with a fair degree of immunity to dental caries.

The second series were those of samples of resting saliva together with samples of activated saliva taken immediately afterwards. These showed with the first pair: resting, 6.40 mg., activated, 7.19 mg.; second pair: resting, 6.56 mg., activated, 6.26 mg.

It is recognized that these determinations are too few to add much of scientific value to the more extensive series in researches already published. The work on the method should, however, be of value to those starting on this work. It is hoped to carry the work forward at an early date and to study in detail the relation of calcium to phosphorus and to hydrogen ion concentration in the saliva in the direction that Ruthrauff[8] is working. Although the relationship of salivary calcium content to susceptibility and immunity has proved so illusory, it has become of interest to determine, if possible, the causes for these variations for their own sake.

Just what is the variation in salivary calcium content related to and why?

8. Ruthrauff, W. M.: Landmarks in Dental Research Leading to the Establishment of the Calcification Theory of Immunity to Dental Caries, Philadelphia: Published by the author.

HIGH HEAT METHOD OF ELIMINATION*

By ALBERT P. GRUNN, D.D.S., Chicago, Ill.

IN presenting the subject of cast gold inlays (high heat method of elimination), I realize that this has been for years a subject discussed by many prominent men in the profession, and to many of you the subject may be old, so to speak; but during the past few years in my work in this very important branch of dentistry, I have come to the conclusion that a large majority of dentists are in need of a thorough training in the fundamentals of inlay making. Men in position to know claim that but 15 per cent of the dentists of the country are doing good inlay work. What about the 85 per cent? There are too many men who are too well satisfied with what they are doing. No man, no matter how good an inlay he makes, should ever feel that he cannot improve on the next one. Personally, I know I have not reached the limit of perfection by a long way, and I am constantly striving to improve my technic, to help my colleagues and to give my patients what I think they are entitled to.

I can understand why so many men in our profession feel the need of something definite in inlay making. They have read of various methods by different technicians, some simple and some complicated, but nothing very definite

*Read before the Section on Operative Dentistry at the Midwinter Clinic of the Chicago Dental Society, Jan. 26, 1928.

*The papers of Drs. Grunn, Volland, Maves and Altfillisch were presented as a symposium on "Gold Inlays from Wax Pattern to Finished Inlay."

as to standardization, or a method that would give them positive results each time. This is one of the most important subjects before the dental profession today.

For many years, I floundered around with this and that technic until I finally settled for a time on the quick elimination, or boiling out method, which gave me very good results, but it was too complicated and the possibilities for failure were too numerous unless the technic was followed strictly to the letter in every detail.

There is no phase of dentistry today that requires more skill than the accurate restoration of a lost portion of a tooth with a gold inlay. When William H. Taggart invented the casting machine many years ago, little did he realize its importance to the dental profession. Many dentists are practicing today who would have been obliged to give up under the old back-breaking gold foil method of filling teeth. Too much cannot be said in praise of Dr. Taggart's gift to the art of dentistry.

In my clinic and teaching experience, I discovered that what the average dentist wanted was an investment that was in a measure fool-proof. By that, I mean one in which, in the event of his having forgotten a case on the fire, being busy at the chair and having carried the case long beyond the time set for carbonization or elimination, he could still get a perfect casting. For years, I have been searching for a high heat investment that would withstand a sufficient amount of heat to destroy any amount of carbon residue without checking or disintegrating, and one in which the low heat or quick elimination method could be employed; in other words, a combination high and low heat investment. This combination I have in a new investment, using the No. 2 for painting my wax pattern and the No. 3 for flasking. The technic I will give you later on.

There are a few things to be carefully considered in the accurate restoration of a lost portion of a tooth with a gold inlay, and if each step is followed closely and carefully with the method that I shall give you, you cannot fail to obtain the desired results. There are four essentials to be remembered in tooth restoration: namely, correct cavity preparation, preservation of interproximal space, proper restoration of contact point and reproduction of the natural contour of the tooth; each one as important as another. Then, to the making of the inlay come the proper manipulation of wax to obtain a smooth pattern, the careful mixing of investments, the painting and flasking of the wax pattern, timing of the investment setting, proper treatment of the gold before casting, and the ability to tell when the gold is in a proper state of fluidity to be poured; each step simple enough yet very important in accomplishing the desired results. The real foundation of all inlay work is correct cavity preparation. The failure of inlays to fit in 90 per cent of castings can be traced directly to faulty cavity preparation. A properly prepared cavity should comply with the following requirements[1]:

1. It should present a series of angles and surfaces best suited to resist stress or tendency to fracture the tooth.
2. It should present margins so prepared as to conserve the enamel structure of the tooth and not expose it to injury during stress of occlusion and mastication.

1. Chayes, H. E. S.: Cast Gold and Porcelain Inlays, St. Louis: C. V. Mosby Company, 1918; p. 65 (Chap. V: Cavity Preparation).

3. It should offer ready access for the making of a wax pattern in the direct method or for the taking of an impression of the cavity in the indirect method.

4. It should offer a retentive receptacle and support the inlay.

5. It should offer a series of angles and surfaces best suited to resist the tendency to dislodge the inlay or filling.

6. It must present margins so prepared that the finished operation will conform as nearly as possible to the highest conception of beauty and form.

7. It should present a form for the reception of the inlay which will bring the various margins into areas of comparative immunity, or in other words, according to G. V. Black's teaching of extension for prevention of further decay.

In cavity preparation, we should aim to conserve tooth structure; and with the hard golds in the market today, we are able to make thinner castings in shallow cavities where we formerly were compelled to make thicker castings with deeper cavities when using softer golds. With the hard golds, we obtain stronger casting with less destruction of tooth structure.

The slice preparation with mesial and distal grooves where there is a minimum of decay at contact points has become quite popular and is of easy preparation, especially mesioclusodistal and three-quarter crown preparations. Most dentists are well informed as to cavity preparations, or should be, yet too many are in too great a hurry to prepare a cavity for an inlay as it should be prepared, and then wonder why they get a poorly fitting casting. I heard a dentist boast of his ability to prepare any mesioclusodistal cavity and make a wax pattern in fifteen minutes. If I can prepare a mesioclusodistal cavity and draw my wax pattern in less than an hour, I am quite satisfied.

The health of underlying tissues is assured by good dentistry. Proper contour is just as essential to the health of soft tissues as proper occlusal surfaces are to masticatory functioning. It is most important that the marginal ridges be broken to act as waste gates for the food during mastication, which massages and stimulates the underlying tissues, keeping them in a healthy condition. Cases have been reported where the underlying tissues became badly diseased shortly after extensive inlay work. Examination showed that waste gates had not been provided by breaking the marginal ridges. This corrected, the diseased tissue soon returned to normal.

CENTRAL AND LATERAL INCISORS AND CUSPIDS

In three-quarter crown preparations for anterior teeth standing in normal position in the arch, the mesial and distal grooves should generally be parallel with the incisal third of the labial plate. With teeth in abnormal position, the direction of the grooves must be varied in proportion in order that the bridge may be easily seated. The success of this type of restoration depends on frictional wall retention, plus groove retention.

For retention in types of anterior teeth which present a thin incisal edge and little or no cingulum for frictional wall retention, a 19 or 20 gage iridioplatinum pin in the pit of the cingulum parallel to the mesial and distal grooves is recommended. Omit the incisal groove to prevent weakening the lingual and labial plates of enamel at the incisal edge.

To avoid damage to the pulp from thermal changes, the casting, when finished, should not be closer at any point than 1.5 mm. If, in cavity preparation, Nature's line angles are followed and the dental anatomic structure reproduced, the horn of the pulp will not be jeopardized.

UPPER BICUSPIDS AND MOLARS

In the preparation of narrow upper bicuspids and molars for three-quarter crowns, a box should be cut on the mesial and distal surfaces for retention in place of a single groove. The occlusal surface of all types of restorations should be narrower buccolingually than the tooth at its widest diameter. This, in most instances, reproduces dental anatomic structure and lessens the stress on the tooth.

With teeth of the bell-shaped type (the lingual surface being long), the lingual preparation should be carried gingivally to a point just below the height of the convexity. If the lingual surface is short, the lingual preparation should be carried to the free gum margin. An acute angle rather than a step placed on the occlusal surface will prevent lingual displacement.

Mesial and distal retention grooves for three-quarter crowns should be parallel on the axial wall. All other lateral surfaces should convert slightly toward the occlusal, sufficiently to sacilitate withdrawal of the pattern but not enough to lose frictional wall retention. The greatest mesiodistal diameter on the occlusal of three-quarter crown preparations is between the mesiolingual and distolingual angles.

Posterior abutment teeth in normal position in the arch, or otherwise in parallel relation, should be grooved parallel with the long axis of the tooth. Abutment teeth not in parallel relation should be grooved in a manner to parallel all retention grooves. This will permit easy seating of bridges.

LOWER FIRST BICUSPIDS

With short lower first bicuspids, where it is impossible to obtain adequate mesial and distal grooves and frictional wall retention, one should make a partial full veneer preparation involving the mesial, lingual, distal, occlusal and two-thirds of the buccal surfaces; also mesial and distal grooves.

LOWER MOLARS

Frictional wall retention is obtained on the buccal surface of lower molars and the lingual of upper molars with a minimum loss of tooth structure. On the lower molars, a double bevel is placed on the lingual cusps for additional retention and strength.

The grooves on the lower molar are placed toward the lingual wall rather than toward the buccal, as on upper molars. In the preparation, the general contour of the tooth is followed. The distance between the tips of the buccal and lingual cusps is practically equivalent to the labiolingual diameter of the tooth just below the cemento-enamel junction.

The use of a No. 700 and No. 701 cross-cut fissure bur for cutting the mesial and distal grooves for three-quarter crowns will give sufficient thickness of gold in the staple.

In the posterior bell-shaped tooth, a full crown is never indicated because plenty of frictional wall retention is always available for a three-quarter crown.

With your indulgence, I shall prepare an imaginary cavity, cast and set a gold inlay, giving each step in detail from cavity preparation to final finish

and setting of the inlay, leaving out, of course, any conversation that might take place between patient and operator in said procedure.

A patient presents, say, a proximal cavity in the mesial side of a right upper bicuspid. The opening into the cavity is started with a No. 701 cross-cut fissure bur. After all overhanging enamel is removed with chisels, and decay is removed with round bur and spoons, I proceed with stones of proper shape to assist in removing undercuts which cause the distortion of wax patterns. The cavity is extended buccally and lingually according to Dr. Black's method of extension for prevention of further decay. With tapered stone, a slight groove is cut lingually and buccally, great care being taken to keep as far away from the pulp as possible. With an end cutting bur, I extend the cavity gingivally to the gum line, tipping my bur mesially in order to give the gingival margin a slight bevel. The final bevel at the gingival is made with gingival margin trimmers. The occlusal step is extended distally beyond the distal pit, then buccally and lingually to a smooth finishing point, care being taken to obtain a square seat to prevent rocking of the inlay. With a fine tapered stone, I resurface the cavity, smoothing the parallel walls to assure a smooth wax surface. Cavo-surface angles are beveled with a round stone to protect the short enamel rods. The buccal and lingual margins are finished with sandpaper and cuttlebone disks. The free use of water poured on the stones when grinding prevents heating up of the tooth, which, if permitted, often causes death of the pulp.

Many failures of castings to remain in position when soft golds are used are due to the fact that dentists do not prepare the occlusal step broad enough bucolingually, immediately over the axial wall, to give casting enough strength at that point to resist lateral stress and prevent the inlay tipping out at the gingival. Buccal and lingual grooves will prevent this gingival displacement.

The cavity is now thoroughly cleansed and presents a typical mesioclusal cavity with box preparation. A thin copper band matrix is now fitted and ligated in position just below the occlusal surface to confine the wax. I am now ready for the wax pattern. As your pattern is so shall your inlay be, if you are careful as to details and follow each step closely and consistently. Inlays will always show the characteristics of the operator, owing largely to the variance of cavity preparation employed and in the manipulation of wax. Care should be taken in obtaining a sharp clean-cut duplication of cavity seats, and the outline and carving ability displayed by the operator will show in the resultant casting, marking it as an honest effort to reproduce form and function with correct marginal fit; or, on the other hand, as a plug to fill the hole.

There are three ways of heating wax: over a flame, in hot water, and in an electric heater. Wax should be uniformly heated and to a point where it is tough and yet will crawl under pressure. Wax heated over a flame to a point where it is brittle and flaky is in no condition for a wax pattern and will present a rough and distorted casting. There are many waxes on the market, but the one to use is the one that has enough body to it to stay in place in the cavity when chilled. Waxes have a relatively high coefficient of expansion. The releasing of internal stresses in a wax pattern after its removal from the cavity, unless confined in a matrix until chilled, in many instances is the cause

of distorted castings. I am convinced that my success in obtaining a marginal fit is due to the fact that my wax was confined under pressure in a matrix until chilled. The cavity is wiped with olive oil on cotton. With the matrix in position and the wax cone in a moldable condition, I force wax into the cavity with a firm pressure of the thumb, maintaining this pressure until the wax is chilled with room temperature water. With a heated ball burnisher, I soften the occlusal surface of the wax and register the occlusion by having the patient bite gently into the wax. The wax is rechilled, the matrix removed, and with wax carvers and burnishers, all excess wax is removed, the operator always trimming and burnishing toward the margins, carving the wax to reproduce the lost portion of the tooth. I smooth the occlusal surface with a pellet of cotton dipped in oil of eucalyptus or alcohol, being careful to remove all excess oil, if used, by squeezing the pellet of cotton between the folds of a napkin, always brushing toward the margins. This is quickly followed by washing the wax with room temperature water to remove all traces of the eucalyptus, which is a wax solvent and, if allowed to remain, would etch the sharp margins. The mesial surface of the wax is smoothed with strips of thin china silk or enamel strips, the operator always stripping toward the margins. A silk strip is passed through the interproximal space, the wax being held in position with pressure distally until rechilled with room temperature water, the ideal temperature for working wax. The wax pattern is now removed and examined to make sure of a slight overlap at the gingival margin, where so many think the shrinkage takes place. I am convinced that the much heard of gingival discrepancy is due to the fact that the wax never was carried to the gingival margin, or else was pulled away after the removal of wax from the cavity due to excessive chilling. The sprue attachment is made at the occlusal surface of wax, mounted on a sprue pin and taken to the laboratory, and the surface is cleaned with a 50 per cent solution of alcohol and water, dried and given a coating of fine powdered graphite, which gives the wax pattern a smooth gunmetal-like finish and brings out all imperfections in the wax. This graphite is brushed on with a very fine camel's hair brush. The wax pattern is now ready to be invested.

In the meantime, I have wiped the walls of the cavity with eucalyptus, filled the cavity with base-plate gutta-percha, with slight fullness at the gingival to force the gum tissue away at that point. The patient is now dismissed and a future appointment made. The wax pattern should be invested as soon as possible after being taken from the mouth to avoid temperature changes.

With the idea of a uniform mix with each investment, I have a balance scale which makes each operation positive as the investment and water are balanced. I first place the right hand cup holder in the No. 2 notch and balance the scale. In the right hand cup, I place a teaspoonful of No. 2 investment and balance by adding distilled water to the left hand cup. The distilled water is always kept at room temperature. You have noticed that the wax pattern has been kept at room temperature throughout the different steps to avoid warpage, which could easily take place were I to subject the wax to a severe chilling or allow it to remain in the laboratory, which might be 20 or 30 degrees warmer. The solution is then poured

into a large spoon and investment carefully added by sifting it into water and mixing it with a minimum amount of spatulation, for spatulation works air into the investment, causing nodules on the casting. To break up the air bubbles, the investment is transferred to a specially designed mechanical mixer of my own design, which gives a smooth, creamy mix. This mixer is attached to the engine hand piece and revolved at from 1,400 to 1,600 revolutions a minute, or high speed for fifteen seconds. With a fine sable brush I pick up the No. 2 investment and carefully paint the wax pattern with investment. The next step in the technic is to me the most important, for it solved a problem that had baffled me for years.

For a long time, I wondered why my castings had a thickened and roughened surface at the sprue attachment side, no matter how smooth the wax pattern had been. I discovered that this was caused by the investment's falling away of its own weight at that point from the wax pattern when mounted on the sprue pin and sprue base; or, in other words, I did not have a close adaptation of investment on the sprue attachment surface. To overcome this, I thought of making small wax rings of thin wax, 24 gage, cutting the wax in strips one and three-fourths inches long and one-half inch wide, and sealing the ends. I attach the wax ring to a glass slab by warming the slab sufficiently to enable the wax to take hold and remain fixed. I fill the wax ring with the excess investment and settle the wax pattern, already painted, into the ring with a trembling motion until it disappears. Then, still holding the sprue pin in my fingers, I work the investment toward the pattern on top with the brush, and when it is centered, I release the pin and wait for the investment to set sufficiently to enable me to cut away the wax ring and mount the wax pattern painted with No. 2 investment on the sprue base. In investing the pattern in the small wax ring, I get a closer adaptation of investment against all surfaces, and in so doing prevent the falling away of the investment at any point, this giving me a more accurate and a smoother casting. The case is now ready for flasking.

No. 3 investment is quite coarse and the proportion for the mix is four and one-half of investment to one of water, or it should be about the consistency of investment for a stone model. When thoroughly spatulated in a plaster bowl, the investment is vibrated into a flask a little at a time around the first painting until the flask is filled. When the investment is set, the sprue pin is carefully removed and the flask is placed on the furnace, sprue hole down, until the investment dries out, when the flask is transferred to the center of the furnace, where the flame is started low and gradually brought up to a high heat, or until the center of the mold reaches a cherry red. This heat can be held at high for an indefinite period without danger of checking the investment. In fact, I have carried a case to the point where the brass flask fused and still the investment remained unchecked. I have purposely left practical cases in the furnace at high heat for four and one-half hours and made perfect fitting inlays. I prefer the high heat method for the reason that the investment expands slightly under heat, enough to compensate partially for the slight shrinkage in the metal when cast.

In the carbonization method of the past, the great difficulty was to determine just how long and at what temperature the investment should be heated

to remove all trace of the carbon residue left on the pattern chamber walls, the thickness of the carbon layer depending on the size of the wax pattern. Formerly, I spent much time in getting a smooth wax pattern, only to have a misfit or distorted casting with feathers, owing to the fact that, in heating my investment sufficiently to destroy the carbon residue, I carried my investment beyond the disintegration point of the plaster binder in the investment. Undercarbonization means that a layer of carbon will remain on the pattern chamber wall and, when casting against it, the casting will be scant by that thickness of carbon, since carbon and gold cannot occupy the same space at the same time.

Tests made at the Bureau of Standards, Washington, D. C., on investments are as follows:

DIMENSIONAL CHANGES ON SETTING

Investments for inlay casting usually expand on setting about 0.25 per cent, accompanied by a rise in temperature of about 5 C. In general, expansion increases as the plaster content increases, though this is not always true.

Apparently, the rate of setting is also a factor. The faster the setting, the greater the expansion. Increasing the proportion of water decreases the expansion in most cases.

DIMENSIONAL CHANGES ON HEATING

All investments tested, including plaster, expanded 0.1 per cent from room temperature up to 125 or 150 C., at which temperature free water is eliminated very rapidly and part of the water of crystallization is given off. The loss of water of crystallization is accompanied by shrinkage, the magnitude of which is largely dependent on the amount of plaster in the investment. From 250 to 300 C., a second expansion amounting to 0.32 per cent takes place.

Heating to from 350 to 450 C. results in a second contraction in which the expansion is lost in some cases and a net contraction takes place. This is probably due to the loss of the remaining water of crystallization.

At about 400 to 450 C., a third expansion begins and continues up to 600 C., when an expansion of about 0.5 per cent is obtained. Above this temperature, little change takes place. Cooling from any of the foregoing temperatures is accompanied by a relatively large contraction.

Investments held at any constant temperature, except within the two contraction ranges indicated, do not shrink, even when held for several hours.

POROSITY OF INVESTMENT

In casting into investment models by any of the methods in common use, it is necessary to provide some means of escape for the air in the mold in order that the space may be completely filled by the entering metal.

While in some cases this may be satisfactorily accomplished by properly venting the mold, in general the porosity of the investment material must be relied on, wholly or in part.

COMPRESSIVE STRENGTH

Strength of investments increases, up to a certain point, with an increase in ratio of water and plaster.

They also increase in strength slightly with an increase in temperature up to 800 C. Any reduction in temperature from the highest point attained during the burning out results in a marked loss of strength, amounting in some cases to 100 per cent.

From this, it will be observed that, in order to take advantage of the tem-

perature at which our investment has the greatest strength as well as the maximum expansion, we must cast at the highest temperature reached during the burning out.

The Bureau of Standards has worked out a casting technic to compensate for the shrinkage of cast gold by expanding the wax pattern, which is as follows:

OUTLINE OF INLAY CASTING TECHNIC

1. Carefully adjust the proportions of water and investment. Use a minimum amount of water.

2. Have the water and mixer warm enough (about 47 to 49 C., depending on the heating retaining properties of the mixer), so that a temperature of 38 C. will result when the investing is completed.

3. Mix in a mechanical mixer, with a stiff flat blade, at from 1,400 to 1,600 revolutions a minute. Most air is eliminated at about this speed.

4. Paint the pattern and fill the ring from same mix. Place the mold in the setting oven, with a temperature of from 40 to 42 C., until hard. Let set at least thirty minutes before starting the burning out.

5. Burn out from two to four hours in an oven at an even temperature of from 300 to 350 C. Start to burn out slowly and do not permit the temperature of the mold to drop below the highest point attained. Avoid the two critical temperature periods in which shrinkage occurs.

It is important to burn out long enough, but relatively unimportant if burning out is continued several hours, provided there is no variation in temperature. Dr. Souder of the Bureau of Standards suggests three and three and one-half hours as the proper time for burning out an ordinary inlay.

The case is now ready for casting. The flask is placed in position in the casting machine. The gold is fused on a charcoal block, and, when cool enough to pick up with pliers, it is placed in a crucible and is quickly fused with an oxygen blowtorch, or blowpipe, to a point that will insure a sharp casting, or just before white heat. Superheated gold is expanded and, when thrown into the pattern chamber, the walls of that chamber limit it and, being greatly expanded, it must contract, causing a poorer fitting casting than when it is heated just enough to cast properly.

A few words regarding the treatment of our metals to get a dense casting: Granted that through strict adherence to technic a correct mold is obtained, a successful casting is largely dependent on clean gold being used (never scraps), and heated to the right state of fluidity. Copper is present in nearly all alloys as a hardening agent. It oxidizes readily in fusing and usually forms into a brittle mass which has little fluidity for casting. Many casting failures are due to oxidation. Molten metals solidify as masses of minute crystals. The strength of a metal depends on the size of its crystals, the smaller the crystals, the denser the metal; the larger the crystals, the more brittle. Gold fused and allowed to cool slowly is not so dense as that cooled quickly for the reason that the crystals in the slow cooling process will be large, while, in the rapid chilling process, the crystals will be small, this giving the metal a greater density. The melting should be done rapidly; slow fusing means oxidation and segregation of different constituents. Great care should be taken to use clean gold and also a clean fusing block, in order that no foreign matter may contaminate the metal, thus spoiling a casting that has taken

hours of preparation. This fact must always be kept clearly in mind: Faulty castings are the result of flaws in the internal structure of the metal which are not visible to the naked eye. In their purest and freshest state, casting alloys are none too good, and the casting technic of the operator always tends to cause them to deteriorate and not to make them better. Excess buttons should be carefully cleaned of compound by pickling in hydrofluoric acid for at least an hour. Buttons which show a rough, scaly or porous surface give evidence of bad oxidation. As much new gold as old, and no more excess than to make a good cast should be used. It is important that the operator should know something of the fusing points of gold, which can be divided into three classes; namely, high fusing (from 1900 to 2000 F., usually high platinum content), medium fusing (from 1800 to 1900 F., usually small platinum content), and low fusing (from 1650 to 1800 F., little or no platinum content).

An oxygen blowpipe is especially essential to high fusing alloys because they should be quickly and thoroughly heated with minimum oxidation; thoroughly, because with their high platinum content, these alloys lose their fluidity in about one-fourth the time of the lower fusing metals; quickly, first, to avoid undue heating and expansion of the mold from too long application of high heat, which invariably results in a distorted casting; and secondly, to prevent coalescence of metallic oxids into crystals and masses, each a point of weakness. Remember that oxids do not alloy with metal. They penetrate the mass and remain in suspension.

Failures in castings are caused by oxidation, and blow holes are directly due to oxidation. The void or defect sometimes found at the junction of the sprue with the casting is believed to be due to the remaining button's freezing before the casting; especially when compression machines are used. This may be corrected by interposing a reservoir for an amount of gold greater than the size of the casting between the button and the casting. This is done by firing a similarly shaped piece of wax on the sprue between the wax pattern and sprue former, at the time of investing the pattern.

Another method of correcting this difficulty consists in using a thin ribbon sprue and an excess of gold equal to the bulk of the casting. High fusing golds pass through five visible stages before reaching proper fluidity for casting: It (1) forms into a button; (2) turns cherry red; (3) becomes spheroidal in shape; (4) quivers under pressure of the blowpipe (caution); (5) approaches white heat (danger); (6) reaches white heat, with boiling and spitting of fine particles from the mass.

High fusing gold should be cast just before the fifth stage, or just before white heat; other golds at the fourth stage, or when they quiver under the pressure of the blowpipe. Carrying gold beyond the fifth stage will destroy its usefulness for casting until it has been refined.

The inlay cast, the flask is immediately thrown into a pan of warm water, and the casting is removed from the investment, brushed, heated over a flame to a cherry red and dropped into sulphuric acid. It is then allowed to remain in hydrofluoric acid for one hour to remove all silicates, and then placed in a saturated solution of sodium bicarbonate to neutralize the acids. When the patient appears, the guttapercha is removed and the inlay is placed in posi-

tion. I leave enough of the sprue wire on the casting to enable me to handle it with pliers. The fact that the sprue attachment is at the occlusal margin makes it easy to place it in and out of the cavity, which is an advantage, especially in establishing the contact point. Having placed the casting in position with a few taps, I seat it and, with a large dull, round bur, I finish the occlusal surface, spinning and burnishing the gold toward the margins. The lingual, buccal and gingival margins are finished with ivory files, drawn toward the margins. The inlay is now removed and the ball contact point established, 20 or 22 carat solder being used just below the marginal ridge. This contact is made positive by determining that the inlay can be lifted in and out of the cavity. The contact established and the mesial surface polished with fine disks, the sprue wire is cut off, the occlusal surface resurfaced with fine stones and disks, and the inlay ready to be set. Cotton rolls and a saliva ejector are placed in position to keep the area dry; the cavity is dried with cotton, and 95 per cent phenol (carbolic acid) is applied to sterilize the cavity, followed by warm alcohol to neutralize the acid. The cavity is then thoroughly dried with warm air, and the cement is mixed, the cavity filled with cement, and inlay forced into position, seated and held under pressure for a short period. When the cement is set, the excess is removed, and the patient is allowed to bite on carbon paper, registering any high points, which are removed with stones. The final finish is obtained with a mandril bristle disk, very fine wet pumice being used first, followed by a paste of powdered chalk or tin oxid, which gives a very high finish and also pleases the patient, who is then dismissed.

25 East Washington Street.

LOW HEAT ELIMINATION*

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IN planning this discussion, it was presumed that a wax pattern possessing qualities which make it suitable for the employment of the low heat elimination technic is provided. The qualities of such a pattern are as follows: (1) the wax must be in adaptation with the cavity details at a temperature closely approximating that of the room; (2) the pattern must be practically free of expansion, contraction and strains or locked elasticity; and (3) it must have been recently made and removed. Such a pattern can be considered comfortable and staple and is not likely to change its dimensions or form provided it is not subjected to changes of temperature or permitted to remain uninvested for a considerable length of time.

When the pattern is made, the next consideration is its mounting on a sprue. It is my custom to remove all mesioclusodistal patterns in biscuspids and all

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mesioincisodistal patterns in incisors and cuspids by attaching the sprue in the center of the occlusal or incisal aspect while the pattern is in the cavity. An explorer tine is used to remove the patterns from the other classes of cavities. The pattern is allowed to remain in the palm of the hand while the sprue is attached at or near the contact point and at such an angle that molten gold may reach all portions of the mold freely when the casting is done.

The technic of attaching the sprue is the same in all cases. The sprue is grasped by the thumb and finger, and its point warmed sufficiently in the flame so that it will readily melt itself into the wax. As soon as it has melted itself into the wax, an assistant touches the sprue (close to my thumb and finger) with a pellet of cotton saturated with cold water. This procedure chills the sprue and causes the wax about the point to congeal, and thus the pattern is firmly fixed to the sprue without subjecting it to extensive or sudden temperature changes.

The manipulation (shaping and polishing) of wax in making a pattern either in the mouth or in a model develops a surface that behaves toward water or aqueous mixtures as if it were oiled. This peculiarity of the surface of wax must be destroyed in order to insure a closer adherence of the investment material to the pattern. Several effective methods are in use. I will mention but three. 1. Dust the pattern with dry investment material using a liberal sized sable brush as a duster. 2. Wash the pattern with soap suds and thoroughly rinse with water. The soap solution and rinse water must be at room temperature or slightly above, if this method is used. 3. Thoroughly bathe the pattern with one of the alcohols just previous to applying the investment. Time should not be given for the alcohol to evaporate and thus to chill the pattern unduly.

After experimenting with many different brands and combinations of investment, I have come to the conclusion that an investment containing more than 50 per cent plaster of Paris has a large and desirable margin of safety in its handling and use. As a matter of fact, the producers of investment materials have gradually increased the plaster content as experience has proved its value. Until now, I know of no investment on the market that contains less than 50 per cent plaster of Paris. I need not recite the reasons given for using the various ingredients that are found in practically all investments, but in reviewing dental literature and discussing investments with manufacturers and practitioners, it is interesting to note that more and more attention is being given to the manipulation and treatment of investments from a plaster of Paris standpoint, as it were, than ever before. The intelligent handling of investments from this standpoint has been one of the factors that have contributed noticeably to the general improvement of inlay results during the last few years.

All materials entering into the investment of an inlay should be the same temperature as the wax pattern; namely, room temperature. A ring and former should be used as a convenience in holding the sprue and pattern and in maintaining the poured investment in contact with the pattern until it has set. It is clearly proved that the size and composition of the ring exerts no influence in controlling the expansion and contraction of the investment when the case is being heated.

The investment material should be mixed thoroughly. This can be accom-

plished by the use of the ordinary bowl and spatula. A mechanical mixer is considered a convenience by some operators. There is no objection to the measuring and weighing of the water and investment, and such a procedure is necessary when a finely specialized technic is employed. It should always be borne in mind that the plaster of Paris content of the investment requires a certain amount of water in the setting process. But in order that sufficient water shall reach every particle of plaster to satisfy its demand and also to make it possible to adapt the investment perfectly to the pattern, and to fill the ring, it is always necessary to use a small surplus of water in mixing investments. Too large an excess should be avoided because such a mixture is accompanied with excessive shrinkage on setting and consequently diminished strength. The mixture should be of a creamy consistency that will allow the following technic to be carried out. The wax pattern is given a thorough painting of this mixture, a liberal sized sable brush being used. Care should be exercised to see that the investment goes into all the irregularities and adheres closely to the entire surface of the pattern. The ring is now placed in position and the investment completed by pouring the investment down the inside of the ring on one side. By this method, the investment fills the ring from the bottom upward, enveloping the sprue and wax pattern and finally filling the ring. It should not be necessary to assist the investment to flow and settle by jarring or tapping. The jarring and tapping of a ring before the investment is set is likely to cause the ever-present air particles to form in larger bubbles and migrate toward the upper surface of the investment. That these bubbles are often caught by the wax pattern is evidenced by the presence of beads of gold on surfaces of castings.

After a little experience, the operator soon becomes accustomed to judging the proper consistency to which any given investment must be mixed in order to complete the technic just described. When the ring is rounded full, the invested case should be permitted to stand undisturbed until the investment has set hard. Ten to fifteen minutes are usually required. The surplus investments should then be cut even with the end of the ring and the former and sprue removed. By grasping the sprue for a few seconds with a pair of rather heavy laboratory pliers whose beaks have been heated in a flame, the sprue can be removed with ease. The case is now ready to put on the heat crucible end down for the purpose of dissipating the wax.

The subject assigned to this paper confines its discussion to low heat elimination or low heat dissipation. This process should not be confused with the so-called carbonization method, which is essentially a high heat technic. By the low heat method of dissipation, the wax is eliminated in three ways: (1) absorption of the molten wax by the investment after the surplus moisture has disappeared; (2) volatilization of the wax, and (3) running of the molten wax out into the crucible through the spur hole. These three phases are named in the order of their effectiveness. In the treatment of an invested case, they work simultaneously. They can be accomplished at a temperature that will not materially affect the desirable qualities of the investment material. Plaster of Paris, the most essential portion of an investment material, will withstand 320 F. for a long period of time without pronounced deterioration of its desirable qualities as an ingredient of an invest-

ment. Silex, graphite, silica and probably some other substances are used in varying combinations with plaster of Paris to produce a material that will withstand more heat without deterioration and distortion than plaster of Paris alone. The addition of these materials merely adds to the margin of safety as far as the use of heat is concerned.

There is no need of taking advantage of this margin of safety although there is no harm in having it present. A temperature of 320 F. is sufficient to dissipate the wax, provided the case is subjected to that heat long enough. Since wax patterns are variable in size, no fixed time for holding a case at this temperature can be set. It will require from one to two hours to dissipate the average sized wax pattern.

Since it is essential to keep the temperature of the investment under control and within rather close limits, it is necessary to use something more than an open flame over which to heat the case.

A heating arrangement that will best answer the purpose must (1) provide control of heat; (2) register the temperature; (3) prevent the flame or heating element from coming in direct contact with any part of the investment or ring, and (4) provide a more or less even distribution of the heat all around the invested case. There are a number of especially devised appliances on the market that fulfill these requirements, but by the exercise of a little ingenuity, a perfectly satisfactory heating appliance can be made by using things that are usually present in a dentist's laboratory.

There is considerable discussion on the merits of casting into a hot or a cold mold. Each has its advocates. In the technic that I am describing, the mold may be taken from the heating appliance and used for immediate casting with satisfactory results, but, in my own practice, the mold is usually set aside until it assumes room temperature before a casting is made in it.

The market provides an array of gold alloys of varying composition. Theoretically at least, each alloy has physical properties that make it desirable for certain purposes. I will not attempt to discuss the subject further except to say that satisfactory castings can be made with any of these alloys. It is the dentist's duty to select the one that is suitable for the purpose at hand.

In making a casting, care must be taken in melting the gold. The melting of gold is really a process of expansion. On cooling from the molten state, it contracts in two stages: the first, from the point of its greatest fluidity to its solidification, and the second, from its solidification to a lower temperature. In the casting process, it is possible to control somewhat the contraction of the first stage. This is accomplished by bringing the gold to a temperature that is just sufficient to permit it to be forced to place in the mold. Thus, the mold is filled with gold that is expanded to a minimum and, during the cooling down to solidification, only a minimum contraction will take place. The contraction of gold from the point of solidification to mouth temperature cannot be controlled. Many operators are using various technical procedures in attempts to compensate for this stage of shrinkage; but, up to the present time, the methods advocated are empiric and the results not constant, in my hands at least.

I have been a staunch advocate of the use of a centrifugal machine for the actual casting. This type of machine has many advantages. As the gold can be melted outside the crucible, little direct heat reaches the investment. Of the

centrifugal machines, those activated by a smooth but quick acting spring seem most desirable because of the almost instantaneous movement of the molten gold into the crucible and into the mold on the release of the spring. When gold is heated to a point only sufficiently molten to insure its adaptation to the walls of the mold, this conservation of time in getting it to place is important.

The question now arises as to what tests can be used to determine how hot the gold should be to make a desirable cast. The ocular test gained by experimentation is about the only guide. On first melting, gold tends to assume a spherical form. If heat is continued, soon a film breaks on the surface of the sphere and retracts down over the sides, leaving a bright mirror-like surface. If the heat is decreased for just an instant, this film reappears, giving a dull lusterless coating. Increase the heat and the film again retracts. Gold is hot enough to cast with a centrifugal machine when it reaches the stage at which it is covered by that mirror-like surface. It will be light yellow. If an air or steam-pressure machine is used, it is advisable to raise the temperature of the molten gold a little higher in order to counteract the chilling effect of the air or steam when pressure is applied in casting.

The melting of gold and its alloys can be accomplished in many ways. It is desirable to melt gold quickly, thus avoiding oxidization and heating the investment. In most localities, the city gas is of a quality that will answer the purpose if a suitable blowpipe is used. If an equipment that will produce more heat is found to be necessary, oxyhydrogen acetylene or some other combination may be employed.

After the cast has been made, it is washed free of investment and pickled in 50 per cent sulphuric acid. The inlay is then carefully examined for defects. The margins should be sharp and the surfaces should be smooth. Any small beads or spiculae of gold projecting from the cavity surfaces of the inlay, owing to imperfections in the walls of the mold, should be carefully removed. The axial and pulpal surfaces of the casting should be relieved about the thickness of ordinary paper. In all inlays except mesioclusodistal and mesioincisodistal, the sprue should be cut and trimmed flush with the surface of the casting. When such a procedure is followed, the inlay does not make contact with the adjacent tooth and thus interfere with the seating of the inlay when it is tried in the cavity for the purpose of examining the contour and adaptation. In the case of mesioclusodistal and mesioincisodistal inlays, 2 or 3 mm. of the sprue is left attached to the inlay. This remnant of the sprue provides a convenient handle by which the inlay may be inserted and removed from the cavity while testing for adaptation and while adjusting the position and tightness of the contacts. When it is determined that the adaptation is satisfactory and the contacts have been adjusted, the remaining portion of the sprue is cut and trimmed flush with the surface of the inlay.

Since, in making a wax pattern, the contact with the adjacent tooth is done away with by the passage of a silk thread between the wax pattern and the adjacent tooth, it is necessary to provide a contact point on the casting. This is accomplished by adding sufficient 18 or 20 carat solder to restore the contour required. A simple method of applying this solder is as follows: Grasp the inlay with a pair of small gage wire pliers. Paint the entire inlay, except that portion upon which it is planned to add

solder, with prepared chalk mixed to a paint consistency with water. This acts as an antiflux. Now by fluxing the exposed surface, the solder can be made to flow to a smooth contour by holding the inlay over a bunsen flame without danger of the solder flowing over the margins of the inlay. After the solder has been added, the inlay is again pickled in 50 per cent sulphuric acid. The inlay is now tried in the cavity, and the contacts are adjusted if necessary.

If proper care was taken in shaping the wax pattern, the casting will need little trimming after the contacts are finished before it is ready to be cemented into place. If, by chance, there is some overlap of gold, it should be trimmed very thin, by using a paper disk rotating so that it cuts toward the margin of the inlay. Finishing of the inlay should be done after it has been cemented to position.

The cementing, finishing and final checking of occlusion of the inlay do not vary in this method, from the cementing, finishing and checking for inlays cast by other methods. The audience, I am sure, is perfectly familiar with this technic and the requirements of these last steps in inlay procedure.

CONTROL OF VARIABLES IN CASTING PROCESS*

By HERMAN A. MAVES, D.D.S., Minneapolis, Minn.

WE are all keenly aware of the outstanding fact that any new procedures which tend to depart from the old, however inadequate the old may be, are not usually met with much enthusiasm. On the contrary, it is the rule that they are accepted slowly. It is not easy for the men who have been doing things in a certain way—teaching and advocating certain methods—to renounce them, much less to admit the fallacy in the things they have been teaching and executing.

We are all prone to meet progress reluctantly, especially if it demands that we cease doing things in the manner in which we have been doing them; and, as we grow older, we are likewise reluctant to take up the new, even though we are able to see its application and true advantages. This is all too human, and it is often difficult to accept the obvious. Nevertheless, it is a great privilege to be connected with a progressive movement. We must develop and bring into action creative impulses, for dentistry has been challenged. In order to be a man, one must take a full step even if obliged to stand alone, as has Dr. Meyer since 1908, when he dedicated his life to service for the upbuilding of the casting process.

I feel confident that courage, enthusiasm and perseverance have brought final success to dental castings. Of all human attributes, an open mind, eagerly expectant of new discoveries and ready to remold convictions in the light of added knowledge and dispelled ignorance

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and misapprehension, is the noblest, rarest and most difficult to achieve.

I am of the opinion that this type of service will receive recognition, for we must have a conviction of our destiny. Therefore, to conserve time, I am going to confine my remarks to the final deductions that Dr. Meyer and I have reached and the unifications and results that we have accomplished during the past five years, hoping to make them worthy of careful and impartial consideration and investigation. I trust that, in their final analysis and application, we may epitomize our deductions relative to the casting process, whereby standardization is in sight; and that we may be capable of rendering suffering humanity a genuine and honest service, by perfecting our mechanical technic in reproducing wax patterns in gold, a technic which has suffered much criticism, and justly so, since Dr. Taggart so ably gave it to the profession in 1907. President Coolidge well states, "It is always very easy to promise everything. It is sometimes difficult to deliver anything."

The casting process is at present in a transitory stage and about to undergo far-reaching modification, which will distinguish it radically from the casting process of the past. The imperfections in dental castings—most of them regarded popularly as perfections—are practically all products of the present generation. The transition from the past imperfect restorations to those nearly perfect is now apparently a simple matter.

The latest addition in the "control of variables" is the attempt at standardization of investments, wax expansion, wax elimination, drying of molds by electricity and casting into a hot mold with from 15 to 20 pounds of pressure, thereby producing smooth, velvet-like castings, inside and outside, which can be easily slipped to place on porcelain or steel models without retouching—an extremely severe test. In working out the foregoing standardized technic, we are, for the most part, indebted to a genuine creative personality.

In this swiftly moving, mechanical age, when the pressure of a button turns on lights, starts fans, sweeps floors, washes clothes, sets dynamos to humming and speeds words across continents and oceans, we are sometimes prone to feel that an individual counts for little. At times, he seems to be a mere cog in a machine, a puppet at a play. He fills his little day with fuss and furor and passes off the stage. Fortunately, no one is indispensable. It would be a sorry world if things went awry when individuals ceased to function. Others fill the vacant places, and humanity moves on.

Despite the vast array of mechanism in the modern world, one comes every now and then upon such clear instances of personal influence, of creative individualism, as to renew one's belief that behind apparent mechanism is a personal influence and guidance. An instance of this kind I found in F. S. Meyer of Minneapolis, who has kindly consented to my reading to you his deductions and technic, as follows:

Wax expands on heating and contracts on cooling. Those are facts that we all know. This expansion or contraction amounts to about 0.1 per cent for every 5 degrees change of temperature of the wax, more or less depending on the wax used. Those changes we cannot disregard, if we wish to employ the material to our best advantage in our work.

Plaster of Paris, we are told by Dr. Harder[1] of the University of Minnesota, expands slightly on heating but contracts

1. Harder, O. E.: Dent. Cosmos, 68: 1129 (Dec.) 1926.

from its original volume—sometimes as much as 1 per cent on being cooled after it has been brought to an excessive heat. Since plaster of Paris is an important ingredient in all our investment compounds, those also are facts that we cannot disregard.

All alloys of gold in our use shrink as they pass from the molten to the solid state. The shrinkage is about 1.5 per cent, more or less, this depending on the alloy used; another fact that we must consider if we are seeking the best results in our work.

All the foregoing facts have been disregarded by the majority in the casting process for the last twenty years. And what have been the results? We all know: large inlays and crowns that can never be properly seated; wide open margins that harbor decay when the cement has washed out; uncovered gingival margins due to mesiodistal shrinkage; compression of the fibrillae of the dentin, causing soreness of the tooth and often death of the pulp; buccolingual expansion of the tooth, often causing fracture of the buccal or lingual cusp, and all the annoyance and trouble that goes with trying to fit round pegs into square holes.

Step by step, we have worked out a technic in which we can utilize to our advantage some of those factors or forces which have always worked to our disadvantage. But, in order that you may be able to understand the reasons for every step in this technic, in order that you may be able to make the best possible castings with the fewest failures, it will be necessary for me to enumerate certain fundamental principles and explain them in detail.

1. The thinner a wax model is, the less the gold casting will be shrunk. As the gold passes from the molten to the solid state, it must reach a certain state of solidity before it is able to compress the investment and shrink in spite of it. The thinner the bulk of gold is, the nearer to the solid state it must be before it can compress the investment and shrink in spite of it; and, consequently, the less the shrinkage registered between points that tend to bind. Conversely, the bulkier an inlay is, the more it registers shrinkage between points that tend to bind.

2. The thinner the occlusal portion of a mesioclusodistal inlay is in proportion to the mesial and distal portions, the less the shrinkage from mesial to distal that will be registered. If the occlusal portion is thin and the mesial and distal portions are bulky, the occlusal portion will begin to congeal and shrink before the mesial and distal portions. It will complete a great part of its shrinkage before the mesial and distal portions are hard enough to overcome the resistance of the investment. Hence, the inlay will register less shrinkage from mesial to distal borders. The converse is true if the mesial and distal portions of the inlay are thin and the occlusal is bulky.

3. The more the wax model is chilled while held in position in the cavity, the less binding there will be in the cast gold inlay. When chilled, wax tends to shrink, but it cannot shrink if the shape of the cavity is such that the tooth prevents it from shrinkage.

In such a case, there must be a rearrangement of the molecules of wax to conform to conditions, or an elastic tension is established with a tendency to contract when the model is removed, or both. The former takes place largely in the early stages of chilling, while the latter takes place more when the wax becomes fairly hard. That elastic tension is largely removed by softening the wax with a

hot instrument some place between points that tend to bind.

If the chilling is carried far enough with a large wax model on a metal or porcelain tooth, the wax will check when the tension becomes too great.

4. The warmer the investment is when it sets, the more expanded will be the wax model. This expansion in turn compensates in a measure for the shrinkage of gold.

5. The larger the sprue hole is, the longer it takes for the gold in it to congeal and the more gold can be fed through it before the gold casting passes the mushy stage. Consequently, the denser the casting will be and the less shrinkage it will register. This, I believe, is the main advantage of the centrifugal machine over the pressure machine.

6. The shorter the sprue hole, the longer the gold in it will remain molten and, consequently, the more gold can be fed through it before it congeals. Hence, the less will be the shrinkage.

7. The better the ring fits the crucible former when warm investment is employed, the less the danger of distortion of the wax model. Theoretically, there should be no water or investment allowed to escape from the base of the ring, causing a settling of the investment, nor any movement between the ring and the crucible former in handling. This is best prevented by a ring fitting into a groove of beeswax on the crucible former and fitting so closely that the crucible former can be picked up by taking hold of the ring.

8. The thicker the investment is mixed, the denser and harder it will be and the longer it will resist the pressure of the cast gold as it passes from the molten to the solid state. Hence, the less will be the shrinkage registered in the cast gold inlay between two points that tend to bind.

9. The more plaster content the investment has, the harder it will be and the more it will resist the pressure of the congealing gold as it shrinks. Hence, the less will be the shrinkage.

10. The less heat the mold is subjected to when the wax and the moisture are being eliminated, the harder and denser it will be and the more it will resist the pressure of the congealing gold; likewise, the less will be the shrinkage of the gold and the smoother will be the finished casting.

The fundamental principle that the harder investments of a higher plaster content cannot be heated to a high degree without destroying their life and resisting qualities marks a critical stage in the wax eliminations.

With large gold castings, it is very difficult to eliminate all the wax without danger of overheating the plaster.

The percentage of moisture in the mold is not always the same, nor is the amount of wax to be eliminated, nor the gas pressure. A great share of this difficulty can be overcome by eliminating most of the wax, or all the wax, before subjecting the mold to the flame, and by bringing the mold to the same point of saturation with moisture for all castings. This is done by a simple device consisting of a small receptacle containing water sealed in by the base of the mold and so arranged that the water when heated must be forced through the mold, carrying the wax with it.

11. The less the foreign matter which may be incorporated in the wax that is left in the mold, the smoother will be the casting. If the wax is forced out through the sprue hole in a softened mass, without being allowed to soak into the investment, all particles in the wax which might be

left as a residue in the carbonization are likely to be carried out with it.

12. The denser and harder the investment, the more the pressure necessary to force the air out of the mold and the gold into it. Here the pressure machines have the advantage over the centrifugal.

13. The denser and harder the mold is, the more pressure it will stand without injury in casting against it.

14. The greater the pressure that can be used in casting, the greater the amount of gold that can be fed into the mold while the gold is congealing and, consequently, the less the shrinkage.

15. The larger the button of excess gold there is in proportion to the size of the castings, the longer it will remain molten. Hence, more gold will be fed into the mold before the casting congeals and the shrinkage will be less.

16. The sooner the gold is cast after being brought to a state of fluidity, the smoother will be the casting and the better will be the condition of the excess gold for future casting.

17. The lower the carat of the gold, the lower the temperature at the melting point is likely to be and, consequently, the less the shrinkage.

18. The less the inlay binds, or compresses the fibrillae of the dentin, the less the danger of fracture of the tooth, soreness or death of the pulp.

All these fundamental principles have been discussed[2] and they constitute common knowledge in a condensed form.

The technic for investing a wax model and eliminating the wax and the moisture from the mold is as follows:

TECHNIC

Fill the groove on the crucible former with beeswax. Then insert a little beeswax into the sprue hole and insert the sprue supporting the wax model. This will prevent the wax model from moving when being painted with investment.

Place about a cubic inch of Meyer and Maves' investment at the right end of a large glass slab.

Fill the large end of Taggart scales with Taggart investment and balance with warm water. Now note this very carefully: If the wax model to be invested is for a full crown, use the water in the bottle in the wax expander at about 130 F. If the wax model is for a bulky mesioclusodistal inlay, dilute the water to about 120 degrees. If it is for a thin mesioclusodistal molar inlay, mesioclusodistal inlay for a bicuspid, a mesioclusal or a distoclusal, any small inlay or a three-quarter crown, do not use water over 100 F.

Make the mix in the small bowl fitted to the wax expander. Stir with a spatula enough to see that the mix is of the right consistency, a heavy cream, and complete the mixing in the recess provided for the bowl in the wax expander. Leave the whip mixer in the bowl until the wax model has been covered with the inner investment. From a water syringe, place a quantity of water on the glass slab covering a space about the size of a dollar or a little more. With a spatula make a mix of water and Meyer & Maves' investment of such consistency that it can be piled up fairly high without flowing. Draw off about a third of this and add to it more investment powder until it is as heavy as you can conveniently paint on your wax model. After painting a little of this on the cavity side of the wax model, rasp the crucible former with a file. Paint on some more of the heavy investment and rasp some more. This causes the heavier particles of the mix to settle, producing a dense surface next to the wax model. It also causes the bubbles and water to rise.

Then paint the rest of the wax model with the thinner inner mix, covering it to the thickness of about one-sixteenth to one-eighth inch, or a little more, and fill in down to the crucible former.

Place the warm ring taken from the wax expander into the groove on the crucible former with a rotary motion. The beeswax in the groove will seal the joint.

Make a couple of turns of the whip mixer and pour the outer investment. Now note this carefully: If the invested model is for a crown, place it on the grate in the wax expander. If it is for a bulky mesioclusodistal molar inlay, place it on another ring in the

2. Meyer, F. S.: Dent. Cosmos, 68:525 (Feb.) 1926.

wax expander: If it is for most any other small inlay, or a three-quarter crown, place it on top of another ring in the wax expander with the door slightly open, or on the top of the wax expander. Always remember this: The thinner the wax pattern, the less the expansion necessary. This is especially true with three-quarter crowns.

Allow to set about forty minutes before eliminating the wax and the moisture. I time this with my roentgen-ray timer.

When set, remove the mold from the wax expander and level off the closed end. Remove the crucible former and sprue. See that the rubber washer is in place in the lower end of the mold compartment of the wax eliminating boiler. Fill the boiler with warm water and place the mold with the sprue end up in the upper compartment. Hold the mold tightly against the rubber washer and empty out all surplus water. Screw on the top part of the boiler so that it holds the mold tightly in position against the rubber washer. Place the boiler in the electric eliminator, or any other eliminator serving the same purpose, and leave until the water boils over and no more wax emerges from the sprue hole. Then remove from the electric eliminator and allow the water to continue to boil for a minute or so.

The whole elimination process should not take over five or six minutes.

Turn the boiler upside down and cool under tap water. Remove the mold and place it in the electric eliminator with the sprue hole up. Remember this also: If a full crown or a three-quarter molar crown is to be cast, leave the mold in the eliminator until all the moisture has disappeared from the sprue hole as shown by subjecting the open end of the mold to a mirror. If the crown is exceptionally long, leave it a minute or so longer.

There is a good scientific reason for this procedure. I believe that most of you have cast crowns when flaw holes would appear in the occlusal portion. Close analysis of this will explain the reason. When you are eliminating either the wax by the carbonization method, or the moisture alone by our method, it takes longer for the heat to reach the end of the core inside the crown than to reach any other part of the mold. It follows, therefore, that if any of the wax or moisture in the mold fails to be eliminated, the failure will be at the end of this core or on the inside of the occlusal portion of the crown. When the molten gold comes in contact with this, be it wax or moisture, there is a sudden expansion of gas produced by the heat from the molten gold, causing a hollowing out of the casting and sometimes a hole clear through the occlusal.

Practice has shown that, by lengthening the time of elimination, in case you are to cast a crown, you will, to a large extent, obviate the foregoing trouble. If an inlay is to be cast, remove the mold from the eliminator while a quickly disappearing cloud still appears on the mirror when placed against the open end of the mold.

The elimination of the moisture should take from sixteen to twenty minutes, varying, of course, slightly with a slight change of temperature of the eliminator and with the size and shape of the wax pattern.

Before casting, place the mold in the wax expander for three to five minutes to allow any trace of smoke or vapor which might be invisible to escape.

If this process is carried out carefully, you can cast a mesioclusodistal molar inlay or a full shoulder crown, smooth inside and outside, that will always go to place with finger pressure on a porcelain model.

I wish to take this opportunity of expressing to Dr. Meyer my sincere appreciation and thanks for his worthy and timely research relative to the perfection and standardization of the technic in the casting process. I feel that the profession also owes him an everlasting debt of gratitude and appreciation. Roosevelt well said, "Every man owes some of his time to the upbuilding of the profession to which be belongs," and this is

my particular reason for attempting to further this masterful and timely research.

Revolution is the demand of evolution. In this age, the wheels of progress are turning rapidly. Today passes and the morrow comes with added problems and new designs. The highway leading toward the goal is open. It can truly be said that dentistry is in step with the procession.

In conclusion, I wish to suggest the perpetuation of the name of William H. Taggart by our profession for giving it the casting process, the perfection of which is in sight, for the welfare of humanity and the advancement of dentistry. Obviously, a strong desire for this perfection is now felt by earnest workers in the profession, and the time is noteworthy because of Dr. Taggart. "Yet hath my night of life some memory; my wasting lamps some fading glimmer left." Such an ideal was accomplished when he composed the casting process out of the inner consciousness of inspired dentistry, and little tampering has been done up to the present time with it in its sovereignty.

The vista continues to widen and new problems, new theories, new viewpoints, loom large before us.

In completing one discovery, we never fail to get an imperfect knowledge of others, of which we could have no idea before, so that we cannot solve one doubt without creating new ones.

RAPID ELIMINATION OF WAX PATTERN (KNAPP METHOD)*

By H. J. ALTFILLISCH, D.D.S., Dubuque, Iowa

TWO important steps in making successful inlays are a good cavity preparation and a wax pattern. G. V. Black has given us a standard for cavity preparations, and a number of excellent articles deserving comment have been written on wax patterns. The most recent article written is by Dr. Volland.[1] If these two preliminary steps are followed out with efficiency and skill, and a standardized technic of wax elimination and casting is added, the production of good inlays will be increased.

The rapid method of eliminating the wax pattern from the flask is accurate and has a standardized technic. It is a reliable method for casting gold inlays in which every pattern is invested and cast in the same manner each time. The ease and comfort of this procedure promotes confidence and assurance; for if each step follows the technic outlined, the results in every case will be the same.

Carelessness and neglect have caused many failures and should be carefully avoided. If the inlays fail to cast smoothly or accurately, the fault is not with the method, but it lies rather in our failure to carry out this method systematically. If an inlay comes out with rounded margins, rough surfaces, bub-

*Read before the Section on Operative Dentistry at the Midwinter Clinic of the Chicago Dental Society, Jan. 26, 1928.

1. Volland, R. H.: Wax Pattern and Casting, J. A. D. A., 14: 1988 (Dec.) 1927.

bles or gingival shrinkage, invariably the cause is laid to the materials or appliances used, whereas, in most cases, we are guilty of carelessness or lack of skill. If success is to be obtained by the rapid elimination of wax, certain materials and appliances should be used, and their use accompanied by accurate technic.

After a wax pattern has been made from a good cavity preparation, it is ready for spruing. A large sprue about 15 or 16 gage in diameter should be used. It is desirable that the sprue former be well shaped, making a crucible which is neither too deep nor shallow, and thus allowing the gold to flow freely into the sprue hole to the cavity pattern. The sprue is placed on the wax pattern as near the center as possible so every part of the pattern is ahead of the port of entry of the gold. This will insure an equal amount of gold being forced into the cavity pattern in all directions. In some cases of large and complicated patterns, it is desirable to use more than one sprue. Before investing the pattern, all blood and mucus is washed off with a fine brush dipped in a solution of Ivory soap and water, after which it is again washed with water. Should we desire to give the pattern a coating that will assist in making a smooth casting before the first investment is applied, a number of preparations will be found on the market that can be used for this purpose. If the pattern is made smooth before being removed from the cavity and cleaned of all foreign substances, there will be no need of this coating.

The investing of the pattern is made of a double investment. For the first investment, it is necessary to have an investment compound of very fine character and which produces such smoothness of the chamber walls that the surface of the casting likewise will be smooth. This is necessary since there is no intervening layer of carbon to assist in forming a smooth surface as in the burning out method. The first investment should have a sufficiently high plaster content to withstand the pressure exerted by the water boiling through it in eliminating the wax. This is necessary so that the surface of the pattern chamber wall will not chip off and produce a rough casting. The first investment is compounded then in such proportions as will give sufficient strength to resist breaking down, and yet with enough interspaces between the silex and plaster particles to allow the air to get away readily.

The outer, or second, investment should be composed of a material having high heat resistance, and which will release the free water readily, so that the wax will be completely washed out. It should be sufficiently porous not to block the air in getting away completely after it has passed through the pores in the first investment. Each investment is devised for the particular purpose that it is intended to serve (a purpose which could hardly be accomplished by any one single investment). Since the characteristic properties of the two investments differ, they could not be used interchangeably.

In mixing the investment, instead of using a plaster bowl and spatula, the first investment, or No. 1, is mixed on a clean dry cement slab with a wide cement spatula. At one end of the slab, about a teaspoonful of No. 1 investment is placed and, at the other end, a small amount of water. A small portion of the investment is drawn into the water and spatulated. The operator continues to draw the investment in until he has a smooth, even consistency and the mixture is stiff enough that it will hold its shape. The heavier that the No. 1 can be mixed

and applied to the pattern, the better the casting and the greater the strength against pressure in casting.

Since we are more concerned with the smoothness of the cavity side than the outer surface of the pattern, it is covered first with the No. 1 investment applied with a small sable brush. The investment is worked ahead of the brush so that it flows smoothly and evenly over the plane surface and into the sharp angles. The same is done to the outer surface until the pattern is completely covered with a thin layer of No. 1 investment, at least one-eighth inch thick. To settle the investment more closely to the pattern, a small gold file is drawn over the sprue former just once. The invested pattern is now set aside and the residue mixture is scraped into a mass for testing purposes. When the testing pieces break with a clean fracture and cannot be crushed between the fingers or water cannot be forced from it, we are ready for the outer or second investment. If the first investment has been properly mixed, this will take about fifteen minutes.

The second investment, or No. 2, is mixed with water of room temperature with an accelerator (in solution). To one quart of water, one level teaspoonful of potassium sulphate is used. This is mixed in advance so that it will always be of room temperature. To get the proper proportions of No. 2 investment and water, an investment scale is used to weigh out the ingredients. This will insure a definite mixture each time, of proper consistency. Unless definite proportions are used, the setting time of the investment will vary, also the consistency will never be uniform. Other means can be adopted for measuring the investment and water, but accuracy is essential for satisfactory results. When the proper proportions have been obtained, the water is poured into the plaster bowl first and then the No. 2 investment is added and thoroughly spatulated until it assumes a smooth, even consistency.

For this method, a thin ring about 1¼ inches in diameter and 1½ inches in height is essential. A heavy ring will require too much heat and defeat the purpose of elimination. The ring is placed on a glass slab and the mixture of No. 2 investment is poured full to the level into the ring, with the aid of the spatula. The pattern covered with the first investment is dipped in water for a moment, so that it will unite better with the No. 2, and the excess water blown off, and then inverting the invested pattern, it is settled into the No. 2 investment with a trembling motion to avoid trapping air bubbles and to assure a close union of No. 1 with No. 2 investment. Settle the No. 1 investment until the former is seated firmly into its correct position on the ring. This is allowed to set until the overflow residue on the ring reaches the same condition of setting as recommended for the No. 1 investment. Unless this is followed out, there are chances of blowups and other failures. The time required for both investments to set is about thirty minutes if an accelerator has been used; otherwise, about fifty to fifty-five minutes. It is better to carry each case through, but if it is impossible to do so, the first investment may be applied and allowed to set for an indefinite time.

When the invested pattern has set the proper length of time, the former and sprue are removed and the flask with the sprue hole is placed in an automatic wax eliminator with a time attachment. The time required for the elimination of wax depends on whether gas or prestolite is used. Usually the time required ranges

from six to eight units on the dial, which is almost equivalent to the same number of minutes. The flame on the eliminator should be properly adjusted for either gas or prestolite to produce uniform results. In order to be sure that the wax has been eliminated, no moisture should show on a mirror when it has been placed over the flask after the flask has been removed from the eliminator one minute or less. Properly timed, there should be moisture on the mirror in every case, but this should disappear in one minute or less after the flask has been removed from the flame. If moisture has not disappeared after one minute, the elimination time should be increased slightly. If no moisture shows when the flask is removed, the mold has become completely dry and the elimination time should be decreased. (In elimination, if a thick ring is used or a flame too high or too low; if No. 2 has not set sufficiently or has set too long after being invested before eliminating, or if moisture is found in the mold, failures of elimination tend to increase.)

After all moisture has been removed, the inlay should be cast immediately to obtain the best results. Long standing will cause a change in the investment as it cools and likewise change the pattern chamber and inlay.

A spring controlled centrifugal casting machine is used, although any satisfactory casting machine may be used with the rapid elimination technic. With a spring controlled machine, pressure can be controlled by the number of windings of the arm. The same purpose is given every time it is wound up the corresponding number of times.

The gold is heated in a separate crucible away from the flask so the temperature of the flask is not affected and the fluidity of the gold is more easily determined than when it is melted directly on the investment compound.

The pressure required with the elimination method will be greater than with the burning out method, owing to the fact that, in the elimination at the time of the casting, we have only the original porosity of the investment material, while, in the burning out method, an added porosity is given by the opening up of interstices between particles of plaster and silica. Therefore, while it is possible to get sharp castings in the burning out method at a certain pressure, the castings would be failures if the corresponding pressure was used in the rapid elimination of wax.

The accurate handling of golds is essential in making satisfactory castings. With every precaution in eliminating the wax, the inlay may still be a failure from burning the gold, in using too hot a flame or heating it too long. Artificial gas and air is most efficient. As it takes longer to melt gold with this combination, it will likewise take longer to overheat it and there are fewer risks of burning. Gold scrap will also tend to cause failures, often being contaminated with solder which contains base metals, and should never be used. An excess gold of at least the weight of the inlay to be cast should be used, for this will insure a casting pressure that will be effective in forcing the molten gold into the cavity pattern. The excess gold can always be remelted for subsequent castings if properly treated and refined.

After a casting has been made, it is removed from the flask, brushed up under running water, then boiled in acid or heated over a flame and dipped into acid, after which it is neutralized in a solution of sodium bicarbonate and water. The cavity side of the inlay is now carefully examined with a magnify-

ing glass for small bubbles. These bubbles are so minute that they cannot be detected with the naked eye and will cause distortion of the inlay when seated if not removed. The grooves and sulci are carved with stones and inverted cone burs and contacts are soldered on at the time the inlay is fitted.

Having completed the preliminary steps, and having followed a definite technic of wax elimination and casting, the inlay produced should meet the desired requirements. Reliable materials and proper equipment are essential, but too much stress cannot be laid on accuracy, care and skill. Certain definite technics and basic principles must be carefully followed and systematically repeated with each operation if the result each time is to be standardized. When this is followed out, the rapid elimination method (Knapp's method) will prove to be a quick and accurate one for investing, eliminating and casting inlays.

PREDETERMINATION OF TISSUE AND STRUCTURAL CHANGES*

By HOWARD H. JACKSON, D.D.S., Detroit, Mich.

IN artificial denture construction, we are faced with satisfactorily surmounting the problems not only of technic and esthetics, but also of stability of the ridge form and ease and comfort of use. No matter how carefully the technical phases of the individual case may have been studied and mastered, unless the supporting tissues and structures are favorable, the patient will be dissatisfied, because of shrinkage, with resulting loss of adaptation, or because of irritation when the dentures are in position.

Some ridges are ideal for denture support in that they are well rounded and present large bearing surfaces, and there will be but little recession noted, many times over long periods of time. This type of ridge is too infrequently met with in practice. Too often the ridges reveal shrinkage or areas of irritation which aggravate the operator and cause the patient to become dissatisfied. No one other than a dentist appreciates what it means to have a satisfied and gratified patient.

There must be some reason for the variation in conditions of the ridge form such as one encounters in daily practice. The probability of discovering conditions that will interfere with success in denture construction can be determined during the period of examination if a careful and complete roentgenographic survey of the edentulous areas is made. The digital examination of the ridge is essential, as, by that means, one can determine the density of the overlying soft tissues and areas of marked tenderness. However, it cannot tell one whether there is a firm cortical layer present, whether there are retained roots beneath the cortical layer or whether there is the

*Read before the Section on Full Denture Prosthesis at the Sixty-Ninth Annual Session of the American Dental Association, Detroit, Mich., Oct. 27, 1927.

necessary cancellous structural support. These things, which are essential to the intelligent handling of any case, can be determined only by a careful roentgenographic examination of each case. In addition, we are enabled to determine the presence of serrated and knife-edge ridges and localized areas of decreased cancellous structures, such as will produce localized areas of irritation after the dentures have been seated. Again, we are enabled to observe spiculae within the soft tissues, such as frequently act as sources of irritation.

In order that the roentgenographic examination may be of value to the examiner, it is essential that the technic be such that the possibilities be recognized to the utmost. The technic is not difficult; neither is it complicated. It requires merely that the time of exposure, the target, film distance and dark room technic be such that the soft-tissue detail will be distinctly registered. Unless the soft-tissue detail is registered distinctly, the informative features will either be destroyed or be rendered indefinite. Spiculae within the soft tissues, which may cause marked localized irritation, are frequently of a density but slightly greater than that of the soft tissues themselves, so that, unless the latter are distinguishable, there will be no record of the irritating agent. The presence of a very thin cortical layer may be missed entirely if the customary idea of the dark-toned roentgenogram is held. If such is the case, the thin cancelli, which are present in many instances when the cortical layer is missing, cannot be distinguished. Such conditions predispose to recession and localized irritation with probable extrusion of spiculae. It is frequently impossible to discover the small knife-edge ridge beneath a thin tissue by a digital examination, but if the details of the roentgenographic technic have been such that the soft-tissue detail is registered, the presence of this decidedly irritating factor is revealed. The presence of serrated ridges is always synonymous with discomfort and irritation. This does not necessarily imply the jagged registration of the deep gashes sometimes observed, but rather shallow saw-tooth formation, unaccompanied with cortical layer registrations, so that the ends of the cancelli are in direct contact with the soft tissues. Such a state of affairs cannot be conducive to comfort under any conditions.

All these conditions which influence the patient's comfort and satisfaction are determined by the correct use of the roentgenogram alone. If such conditions are present, the difficulties which arise after a denture has been placed in position may not be due to lack of balance or faulty technic, but to deficiency within the supporting structures themselves. The time to determine the possibility of discomfort is preceding the construction of the denture and the roentgenogram is the only means in which these changes can be recorded.

DISCUSSION

Hugh W. MacMillan, Cincinnati, Ohio: In order to interpret the roentgenographic appearance of edentulous jaws, it is necessary to be familiar with the mechanical laws which govern the rebuilding of the alveoli after extraction of the teeth. Careful examination of roentgenograms of the alveolar border of the edentulous mandible shows the character of the bone to be decidedly different from that of the maxillary border. The superior border of the mandible in the molar region is composed of a dense layer of bone which corresponds in thickness and density with the inferior border. In cross-sections of edentulous mandibles through the molar regions, it is impossible to tell the difference between the superior and inferior border unless other determining anatomic landmarks are taken into consideration. The histologic

examination of the superior border of the mandible shows the former opening of the molar alveoli to be occupied by haversian bone, while those parts of the former alveoli which no longer resist the leverage of the roots are replaced by cancellous bone of a wider meshed pattern. These changes at first appear confusing but are soon explained by the application of the law of bending stress which rules that "to resist bending moment stresses most effectively the material should be as far from the neutral axis as possible. . . " The alveolar border of the edentulous maxilla does not present this thick dense layer as it is under a different mechanical stimulus governing its rebuilding. Being on an immovable base, it is not subjected to leverage as is the mandible. The chief forces are compressive in nature and are produced by the impacts of food in mastication directly or by the interposition of a denture. Compressive forces are met in the most economical manner by cancellous tissue, the spacing of the cancellations being in proportion to the stresses produced. Another point which should be emphasized is the relative position of film, alveolar border and direction of the ray. Roentgenograms made from the angle usually employed for dental examinations are valueless in a careful study of the alveolar border. The interproximal technic is here applied to good advantage as by this means the alveolar border can be depicted without the interposition of other structures. The most stimulating part of the paper is the effort to anticipate the changes which occur in the stability of the ridge form. The time will come when artificial dentures will be scientifically designed to furnish functional stimulation to the alveolar ridges instead of producing disuse or pressure atrophy. Additional research in the functional adaptation of the edentulous jaw to functional requirements will hasten the prosthetic millennium.

AN ANAEROBIC ORGANISM RESEMBLING LEPTOTHRIX ISOLATED FROM THE MOUTH*

By PHILIP JAY, D. D. S., Rochester, N. Y.

THE earlier workers in dental bacteriology have contributed rather confusing reports on *Leptothrix buccalis* and *Bacillus buccalis-maximus*. Robin[1] was not able to cultivate *Leptothrix buccalis,* but, from his studies of smear preparations, he observed that it grew out into long unarticulated threads. Vignal[2] succeeded in cultivating an organism which he believed to be *Leptothrix buccalis*. Among other things, he observed that this organism grew out into long threads. These threads were distinctly articulated. W. D. Miller[3] later described *Bacillus buccalis-maximus* as a large bacillus, from 2 to 10 microns long. These organisms, as a rule, formed long articulated threads.

This paper deals with an organism which, when grown in pure culture,

*From the Department of Bacteriology, School of Medicine and Dentistry, University of Rochester.

*Read before the Section on Histology, Physiology, Pathology, Bacteriology and Chemistry (Research) at the Sixty-Ninth Annual Session of the American Dental Association, Detroit, Mich., Oct. 26, 1927.

1. Robin: Organisms Which Breed on Living Animals, Paris, 1847, p. 42.

2. Vignal: Research on the Micro-organisms of the Mouth, Arch. de physiol. norm. et pathol., 1886, p. 325.

3. Miller, W. D.: Micro-organisms of the Human Mouth, Philadelphia: S. S. White Publishing Co., 1898, p. 73.

tallies very well the above mentioned forms as they are described.

ISOLATION

Blood-agar plates were streaked with débris taken from cases of advanced dental caries. For this purpose, Douglas

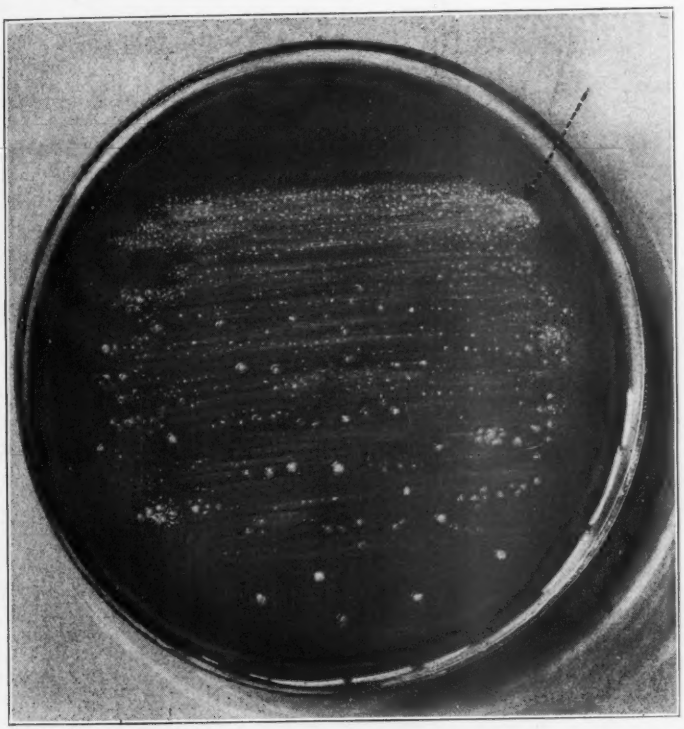


Fig. 1.—Two day anaerobic culture of débris on blood-agar from case of dental caries. The area indicated by the arrow is shown in Figure 2.

medium, p_H 7.6, with 2 per cent agar and 5 per cent rabbit's blood was found satisfactory. The plates were placed in an anaerobic jar and incubated at 37 C. for forty-eight hours.

Within forty-eight hours, a profuse foul-smelling growth is obtained. (Fig. 1.) This growth consists largely of coccoid forms, many gram-negative bacilli and spirilla. Isolated colonies of the desired organism are rarely found on these first plates. A careful examination of such a culture will reveal a very delicate growth which seems to radiate from under the heavier growth out on to the clear agar. (Fig. 2.) A second plate inoculated with this material will yield a luxuriant growth of this organism in pure culture.

MORPHOLOGY

The organism is a gram-positive rod measuring 0.3 micron in width, and may

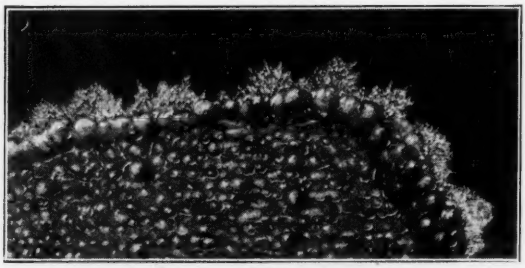


Fig. 2.—Portion from culture shown in Figure 1; × 10.

vary from about 8 microns to an extremely long filament extending across the entire field. It is easily stained with methylene blue, carbol fuchsin and the usual basic anilin dyes.

The rods may occur singly or in chains of three to eight or more cells. (Fig. 3.) The isolated rods are at times somewhat tapered, though, not infrequently, clubbed and swollen ends occur. (Fig. 4.) The thread forms are often wavy and all of the strains studied have the unusual tendency to form coils with turns of mechanical uniformity. (Figs. 5 and 6.) In the latter respect, the organism resembles Weible's[4] "Vibrion aus nasenschleim." (Fig. 7.) Often, two organisms may be seen wound around each other in cable fashion. (Figs. 8 and 9.) In all cultures it was noticed that the threads may be either articulated or uninterrupted in their entire length. (Fig. 10.) The articulated threads, it will be noticed, are very similar to Miller's *Bacillus buccalis-maximus,* while the long solid filaments are typical of the leptothrices.

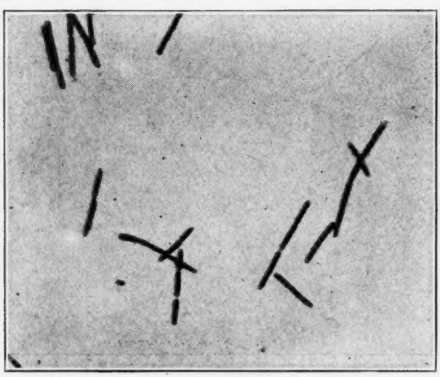


Fig. 3.—Forms resembling rods and chains of so-called Bacillus buccalis-maximus from forty-eight hour culture on blood-agar. (Gram stain, magnification approximately × 1,000.)

4. Weible, E.: Investigations on the Vibrio, Centralbl. f. Bakteriol., Sec. I, (orig.), 11: 465, 1887.

Fig. 4.—Swelling at end of filament from forty-eight hour culture on blood-agar. (Gram stain; magnification about × 1,000.)

Fig. 6.—Typical coil from forty-eight hour culture on blood-agar. (Gram stain; × 1,000.)

CULTURAL CHARACTERISTICS

Hartley's[5] modification of Douglas' medium with 2 per cent agar and 5 per cent blood was found most satisfactory for isolating this organism. On plain agar or meat infusion-agar, little or no growth occurs. In some instances, a slight growth was obtained on the first transfer to meat infusion-agar, but it was not possible to secure a growth after the second transfer to mediums which did not contain blood or hydrocele fluid.

Glucose-meat infusion broth, brain broth, milk, whey-agar, casein digest-sodium oleate-agar and gelatin are unsatisfactory.

A meager growth may be obtained with Loeffler's serum and ascitic fluid agar. Hydrocele fluid agar may be used

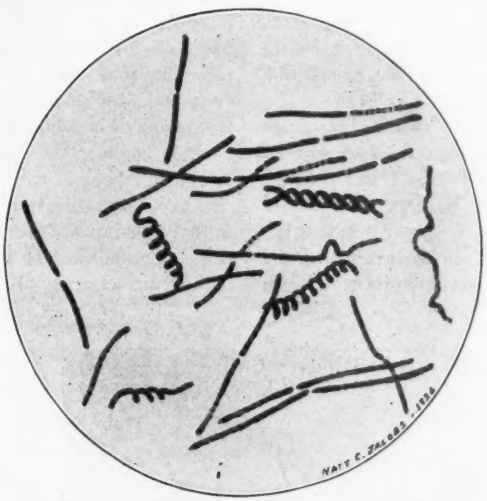


Fig. 5.—Coiled and braided forms; × 2,200.

5. Hartley, P.: Value of Douglas' Medium for the Production of Diphtheria Toxin, J. Path. & Bacteriol, 25: 479 (Oct.) 1922.

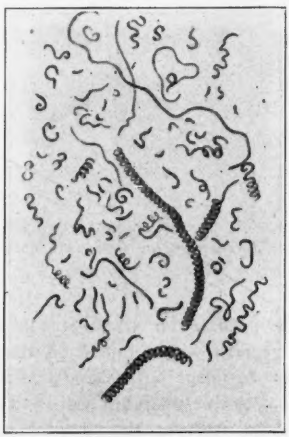


Fig. 7.—Coils of filamentous organism isolated from nasal mucus. (After Weible.)

Fig. 8.—Braided filaments from three day culture on blood-agar. (Gram stain; × 1,000.)

with some satisfaction, but blood agar is excellently suited for this organism. Growth in broth was obtained only with difficulty. All tests for the production of indol were negative.

On blood-agar, the colonies vary from 1 to 3 mm. in diameter. The smaller colonies are slightly raised and circular and have discrete borders. The older colonies are much larger, measuring from 3 to 4 mm. in diameter. In the middle of each colony is a whitish papule from which the colony substance seems to radiate. Immediately around this peak, the matrix is uniformly dense and of a grayish tint. Toward its periphery, the colony breaks up into hair like filaments which terminate in three or four tufts. These tufts generally take on an S-shaped curve, giving to the colony a whorl appearance. Such typical colonies often appear within forty-eight hours.

The pure cultures have a slightly musty odor but are not foul. The organism is nonmotile. It is apparently not pathogenic. Large amounts of heavy

Fig. 9.—Smear from three day culture on blood-agar. (Gram stain; × 1,000.)

suspensions in saline solution were injected into guinea-pigs, both intraperitoneally and subcutaneously, with no untoward results.

The optimum temperature for growth is 37 C. A scanty growth may be obtained at 40 C. No growth takes place at from 18 to 20 C. It does not hemolyze blood and produces no pigment. All strains studied produced acid without gas from glucose, levulose, mannose, lactose, sucrose, raffinose, arabinose, xylose, mannite, dulcitol, sorbitol and inositol. For a more detailed account of the biology of this organism, the reader is referred to a previous paper.[6]

Fig. 10.—Smear from forty-eight hour culture on blood-agar, showing spirals and coils. (Gram stain; × 1,000.)

COMMENT

The organism described above is an anaerobe and can be very easily isolated from carious lesions of the teeth. Though they utilize carbohydrates to form acid, their status as an etiologic factor in dental caries is extremely doubtful.

In a recent paper, Varney[7] describes several strains of *Bacillus fusiformis*. One of these strains is very similar to the organism which I have described. I am, however, extremely hesitant to include it in the fusiform group, and, pending further investigation, I shall reserve its classification for a future paper.

Morphologically, this organism might well be classed as a leptothrix. As seen in the fresh material from which it is isolated, the organism is filamentous. In culture, it grows out into long non-branching threads, though unusually large bacillary forms occur. It differs from the leptothrix described by Vignal, in that Vignal's organism grew very well aerobically on blood free mediums. The pleomorphism of this organism is probably responsible for the differences of opinion advanced by early workers who were not able to observe the organism in pure culture.

DISCUSSION

Theodore B. von Beust, Louisville, Ky.: Did I understand that these particular slides were taken from the culture?

Dr. Jay: Yes, except the first one.

Dr. von Beust: The long thread-formed organism, the one showing no septation, I would interpret as *Leptothrix innominata*. The one which Dr. Jay tells us demonstrated *Bacillus buccalis-maximus*, actually appears, as far as can be judged from the photograph, to resemble it very closely indeed. Now, the germ *Bacillus buccalis-maximus*, as described by Miller, grows to the length of from 100 to 150 microns, and is septated, has another and shorter septation and is about 1.5 microns in breadth.

Dr. Jay: Mine is about 3.

Dr. von Beust: The photograph certainly resembles the picture presented by Miller.

Faith P. Hadley, Ann Arbor, Mich.: I have seen some slides somewhat similar to

6. Jay, P.: An Anaerobe Isolated from Dental Caries, J. Bacteriol., 14:385 (Dec.) 1927.

7. Varney: Serological Classification of Fusiform Bacilli, J. Bacteriol., 13: 275 (April) 1927.

these. I have succeeded in growing some of the organisms on semi-solid mediums. Those curved forms I have seen often in 10 per cent agar. I was wondering if, after growth under anaerobic conditions, this organism would grow under partially aerobic conditions; for instance, on the bottom of semisolid agar.

Dr. Jay: The first few months I was unable to get a good growth unless the anaerobiosis was complete. However, I noticed that one of our older strains would grow under partial anaerobiosis in rubber stoppered tubes. I could never get growth until I added blood to the medium. We use 2 per cent blood-agar. It was extremely pleomorphic and would not grow in gelatin at all. I could not get a satisfactory broth culture. The organism is apparently nonpathogenic. I injected quite large doses intraperitoneally, with no results. I tried to produce an abscess in the inguinal glands but failed.

ORTHODONTIA AS PREVENTIVE DENTISTRY*

By G. B. STEADMAN, D.D.S., St. Paul, Minn.

LAST year, Frederick B. Noyes, of your society, read a paper before the St. Paul District Dental Society on "Preventive Orthodontia." It is well, in this rapidly progressing dental age, to have this exchange of dental ideas and problems between widely separated parts. We shall not always be in perfect accord, so it is well that we have criticism and discussion. Constructive criticism is always a boon to progress.

When men gather from distant places, there must be a vital reason for it, and underlying that reason must be a common faith in our work, a broad charity to our competitor and an unending hope in good. If it were not for these motives, you would not be here today. And so it is with the practitioners of the various branches of dentistry. The idea of reciprocity should be continually practiced, not only at our dental meetings, but in our dental offices as well.

Orthodontia, which should be of the greatest importance to the general practitioner of dentistry, has been progressing so rapidly the last few years that those who have not devoted a large part of their time to study, and to an attempt to keep up with the subject, have missed many important steps in its development.

Some of the orthodontic teaching of the past and present has had far-reaching influence on many of the various branches of dentistry. Some of the theories advanced have been accepted by the general practitioner of dentistry and they hold, at the present time, as important a position as regards their special branch of dentistry as the latter holds for orthodontia.

I shall simply mention two orthodontic terms: "occlusion," and "line of occlusion." We have always made use of occlusion in our work, but it was not until Dr. Angle brought forth his classification of malocclusion that the profession awakened to the full meaning of occlusion. This certainly was an important epoch, not only in orthodontia, but also in dentistry as a whole.

*Read before the Section on Orthodontia at the Midwinter Clinic of the Chicago Dental Society, Jan. 24, 1928.

How far would a dentist specializing in the reconstruction work of today advance if he did not consider the question of normal occlusion and also the question of establishing the balance of the entire dental mechanism? I am sure that he would have just as many failures as the orthodontist who did not consider their importance. He is striving to build all of the teeth into their normal position and establish harmony and balance of all parts; in other words, he is striving consciously, or unconsciously, to reconstruct and bring all parts into the "line of occlusion." I wonder how many in the dental profession know the true meaning of the term "line of occlusion."

I mention the foregoing that you may realize that many of our orthodontic problems are just as much the problems of the general practitioner and should be studied as such, because they pertain to preventive dentistry.

I wish to say just a few words to the general practitioner of dentistry who desires to do some orthodontic work, concerning the preliminary examination and care of the mouth during treatment as a means of preventing dental caries. What do we look for when making an orthodontic diagnosis? Do we confine our observation and study simply to beautiful models when determining the class and etiology of the case? Accurate models are necessary for each case, but it is also necessary that study be made of the patient and all factors that have a bearing on the case, covering the anatomy, physiology, etiology and function of that individual case.

When a child has come in for orthodontic treatment and a diagnosis has been made, the "bite-wing" roentgenograms often show small interproximal cavities. Often, by the ordinary method of examination, these cavities are discovered with difficulty. If these approximal cavities are not filled and bands are placed on the teeth, it will be found, in some mouths, on removal of the bands, that decay has progressed to a marked degree.

My experience has been that the dentist is glad to cooperate with the orthodontist when shown the "bite-wing" roentgenograms. In the past, much of the decay occurring under orthodontic bands has been caused by neglect to observe closely all the surfaces of the teeth before starting orthodontic treatment. This neglect also includes failure to place preventive fillings in the occlusal fissures and pits of teeth. Do not overlook the great importance of preventive fillings.

We all know that teeth which have had well fitted and firmly cemented bands are not so liable to decay as the adjacent teeth or teeth which are not banded.

The greatest of care should be taken in the fitting and cementing of all bands for orthodontic purposes. If one is neglectful in regard to either fitting or cementing, decay and disease are liable to follow.

It is well to reinforce the lingual surfaces of the upper anterior bands with solder, especially for Class II, Division 2 cases, because of the extreme overbite, which causes undue stress on the lingual surfaces, exerted by the lower anterior teeth when occluding, thereby loosening the lingual surfaces of the bands and causing leakage. I have made it a practice to reinforce the lingual surfaces of all upper anterior bands, regardless of the class of malocclusion, thus insuring little trouble from breakage and decay. It is, of course, understood that all mouths must be continually watched for

the loosening of bands during the entire treatment of the case.

When using platinum alloy arches, it is advisable not to let the arch rest in close contact on any enamel surface for any continuous length of time, as it is liable to decalcify the enamel surface.

The careless use of wire and silk ligature often causes a pathologic condition. It is well to use silk ligature only when provision has been made to prevent the ligature from slipping gingivally.

As regards the prophylactic care of the mouth during orthodontic treatment as a measure of preventive dentistry, it is not my intention to tell you what prophylactic procedure should be followed for this or that patient, but I will say that great good would come to all orthodontic patients if more cooperation could be had between the orthodontist, dentist, patient and mother. It is the duty of the orthodontist not only to correct the malocclusion, but also to supervise the care of the mouth while the patient is undergoing treatment by him. He should see that the mouth is kept clean, watch all surfaces of the teeth for caries and refer the patient back to his dentist at intervals when it is necessary.

More care should be given to a patient with orthodontic appliances on the teeth than to one not wearing appliances. The child comes to the orthodontist at definite stated times for treatment. Is it not the most opportune time for cleaning the teeth and observing the general condition of the mouth when the arches have been temporarily removed from the mouth?

The mother usually accompanies the child on its first visits to the orthodontist. These visits afford a golden opportunity for teaching the mother, as well as the patient, the great importance of sanitary mouth conditions, especially during the orthodontic treatment. The child should be taught a daily routine of cleaning the teeth and its importance to him. Many children can be taught, and some mothers are not too busy to see that the child gives the necessary daily attention to his teeth. This class, I believe, is in the large majority. But some children cannot and will not be taught, and to them the greatest attention and care should be given. If the child will not keep his mouth reasonably clean, there is an added responsibility which the orthodontist and dentist must assume, in order to prevent future dental trouble.

It has been said that, "Cleanliness is next to godliness." After seeing some unclean mouths with orthodontic appliances, one can believe that the author of that phrase might easily have been an orthodontist.

The longer I practice orthodontia, the more certain am I of the absolute need of close cooperation between the operator in any orthodontia case and the rhinologist. It has long been known to the rhinologist and the orthodontist that normal breathing is of grave importance to the normal development of the nose, jaws and face. Adenoids and enlarged and diseased tonsils are important factors in causing mouth breathing. As an orthodontist is not competent to make a nose and throat examination, it becomes necessary that the patient be sent to a rhinologist for a thorough examination. The diagnosis is of the greatest importance to the orthodontist, for on it depends largely the success or failure of his orthodontic work.

Has the general practitioner of dentistry realized that a normal nose and throat are of equal importance to the longevity of the restoration to the teeth, partial dentures and normal general mouth conditions?

An orthodontist, by advising a mouth-breather to consult a rhinologist in order that normal breathing be restored, and afterwards correcting the malocclusion for that patient, has accomplished much good in the way of preventive dentistry and for the general health of that patient. When we know that adenoids and diseased tonsils cause some form of malocclusion and that malocclusion is the cause of dental caries and disease surrounding the teeth and tissues of the mouth, does it not seem reasonable that the general practitioner should be well informed in regard to orthodontic problems, in order to be able to give to his patients the full benefit of this knowledge? We should be able to recognize readily a mouth breather and patients with abnormal habits, and should not permit them to come to our offices year after year without recognizing this condition and advising them accordingly. If the general practitioner feels that he is not capable of giving correct orthodontic advice and treatment, he should see to it that the patient receives this advice and treatment from some one well qualified. This does not mean that he should let the child go until it is 12 or 14 years of age before advising treatment; by that time, much harm usually has been done, not only from an orthodontic standpoint but from a dental standpoint as well. It is necessary to refer these patients early for two reasons: (1) to prevent further caries and disease, and (2) to give Nature a chance to assist in the development of the jaws through the eruptive force of the teeth and during the developmental period in general.

We are all familiar with Class III, or the prognathous type of malocclusion, and know what marked deformity often accompanies it. We also know the pathologic condition of the tissues surrounding the teeth and the active decay often accompanying such cases in the adult. It is difficult to make proper restorations and reconstruction work in such types of malocclusion in the adult. It is also known that enlarged and diseased tonsils often are the direct cause for Class III cases.

Now, when we know all this, does it not seem a crime for this type of malocclusion to become such a deformity in the adult when it could have been so easily corrected in the child? Early correction of this type of malocclusion is truly preventive dentistry. We must see to it that this condition is corrected early, even at the age of 3, when such a trail of abnormal dental conditions is the direct result of postponement of the correction of this type of case. The time is at hand when it is the duty of both the orthodontist and the general practitioner not only to be able to perform dental operations well, but also diagnose malocclusion properly and to recognize pathologic conditions of the nose and throat as well as abnormal habits.

Concerning the definite place orthodontia occupies in the field of preventive dentistry: It has long been taught that malocclusion is one of the great predisposing causes of dental caries. One of the reasons for decay is the overlapped and crowded condition of the teeth, which destroys the normal approximal contact and prevents normal occlusion of the teeth. These overcrowded approximal spaces between the teeth are favorable places for the catching and wedging in of food. They are hard to keep clean and are often avoided when the teeth are brushed. Often soreness and bleeding of the gums result, and eventually a pathologic condition develops in the approximal spaces, which, if allowed to remain, may spread to larger areas.

Not only are these overlapped and crowded approximal contacts favorable places for decay and disease; they are also unfavorable places for the placing of approximal fillings, because of the poor access afforded the operator while making the filling and because of the abnormal position of the approximating contact point with the adjacent tooth. And even after as nearly ideal restorations as possible have been made, conditions are still unfavorable as regards permanency of the work, unless orthodontic treatment is resorted to, because the original predisposing causes for decay and disease are still present.

I wonder how many orthodontists have treated and dismissed a case as corrected, say at the age of 10, and, after a lapse of several years, have observed that the lower second molar has erupted lingually to the upper second molar? This is a most distressing situation from an orthodontic standpoint and equally so from a dental standpoint, and, if not corrected, it predisposes to decay because of abnormal approximal contact and is associated with disease in that area. Why do we usually find a pathologic condition surrounding lingually tipped molars? I think that it is because of the continual pounding or occluding of the cusps of the teeth of the opposing jaws in the wrong direction. This force eventually throws the crowns of the teeth out of the "line of occlusion," so that the lingual cusps of the upper molar occlude with the buccal surface of the lower molar; in other words, the force of occlusion is not distributed on the long axis of the teeth. Of course, further orthodontic care would be necessary, not only to move these teeth into normal occlusion so that the second molars can assume their normal axial stress and restore the normal approximal contact between the first and second molar, giving Nature a chance to overcome the pathologic condition, but also, and of equal importance, to aid in the further development of the jaw.

We have all observed similar conditions when the third molars attempt to erupt, causing swelling and soreness of the soft tissues and predisposing to caries. The easiest procedure, of course, is extraction of the third molar, and it is here that real judgment must be used; for it must always be remembered that the third molar is a great factor in exerting pressure for further development of the jaw, as it occupies the same relative position in the adult jaw as the second permanent molar does in a child of 12 and the first permanent molar does in a child of 6, and performs the same function, namely, furthers development.

There has always been an erroneous idea that the third molar is of little value in the mouth, that its structure is much inferior to the rest of the teeth, and that it should generally be extracted for sanitary reasons. It occupies a position, anatomically, which makes it very difficult to keep it clean, in many mouths, and, therefore, it is much more liable to decay than the other teeth. However, I have seen in a normally developed adult mouth third molars which have fully erupted, have taken their position in the arch and have performed the function of mastication, with no caries or disease present. These teeth evidently had not only contributed largely to the development of the jaw but were also affording support to the other teeth. If these teeth had been extracted before they had fully erupted, further pressure would have immediately stopped and the distal support of the second molar would have been lost, which, in the adult, is very important.

The orthodontist, in the treatment of many cases, can be of the greatest assistance in promoting preventive dentistry if he will supervise his cases until the third molars have erupted and have taken their normal position in the jaw.

Many third molars are so inclined that they can never erupt normally, and they often are held in infraclusion by the distal surface of the second molar. This condition predisposes to caries and disease and thus neglect of the third molar has often been the cause of the loss of the second molar. Many third molars have been extracted which should have been retained in the mouth for developmental purposes. I do not wish to convey the impression that I believe that third molars should never be extracted, but I do believe that judgment is required.

The general practitioner, principally or altogether concerned with the adult, many times faces other extremely difficult problems in all fields, such as caries, disease of surrounding tissues, teeth out of normal function, extreme overbite, protruding upper anterior teeth and infraclusion of posterior teeth. Since all of these conditions could probably have been corrected in childhood, does it not seem that orthodontia holds a very important place in preventive dentistry?

CONCLUSION

The points that I have tried especially to emphasize are:

1. To the general practitioner who desires to do some orthodontic work.

(a) The careful examination of all surfaces of the teeth before starting orthodontic treatment by use of the "bite-wing" roentgenogram.

(b) The placing of all necessary preventive fillings.

(c) The careful fitting and cementing of bands.

(d) The careful use of platinum alloy arches and bands.

(e) Judgment in the use of wire and silk ligature.

(f) Necessity of educating the child and mother relative to daily routine for mouth cleanliness.

(g) Prophylactic care, the duty of the orthodontist toward his patient during the period of orthodontic treatment.

2. Close cooperation in orthodontia cases between the operator and the rhinologist in the observation of patients as regards the nose and throat conditions.

3. The definite place orthodontia occupies in the field of preventive dentistry as regards the importance of normal approximal contacts and normal occlusion as a means of preventing predisposing causes of caries and disease.

The necessity of retaining in the mouth all teeth, with special emphasis on the third molar.

DISCUSSION

Austin F. James, Chicago, Ill.: There is not a day in my practice of periodontia that I do not wish for the cooperation of the orthodontist that I might better develop definite results. Malocclusion plays a large part in the cause of periodontal disturbances and of many other dental ailments, as well as retarding the development of the air passages or breathing spaces. We find some cases in which all or several of the above mentioned conditions exist, yet we find no excessive dental disease present. Again, we see well developed dental arches and almost perfect occlusion in the mouths of normal healthy children, but find the teeth and supporting structures in a deplorable condition. I approve of Dr. Steadman's recommendation for early orthodontic attention, also for retention of the third molar when proper hygienic methods can be taught. The greatest problem in dentistry is lack of function. We have been given a machine for incising, tearing and grinding. If that machine were in normal use, there would be less need of orthodontic employment. I have no suggestions to offer as to how this lack of function can be

overcome, but after the orthodontist has done all that is possible to assist nature in expanding dental arches and developing the line of occlusion, I do believe much can be done toward building up resistance of all supporting structures by teaching the proper use of the toothbrush. I have cases in my practice in which proper brush stimulation has developed resistance even in the presence of traumatic occlusion and has helped to maintain teeth in the position established by orthodontic treatment.

REFITTING CONTINUOUS GUM DENTURES*

By JAMES L. HOWARD, D.D.S., Hollywood, Calif.

THE continuous gum denture, from the standpoint of esthetics, has always been considered the supreme achievement in the art of denture prosthesis, and it has long afforded the artistically inclined dentist an unlimited field of opportunity for the exercise of his skill. Unscientific methods of construction have been so complicated, and uncertain, and so often discouraging, that few have felt that they could afford to risk their time and reputations when the chances of success were such a gamble. By an improved method of construction, recently demonstrated and published, practically all of the uncertainties of the older technics have been overcome, and simplicity and accuracy are exemplified.

It is now possible to make a continuous gum denture that is not only artistic and beautiful in appearance but also lighter in weight, yet strong, simple to make and sure to fit the model when finished.

No denture is a real success unless it can be repaired or refitted, and this has been one of the most objectionable features of the continuous gum denture. If an inexpensive vulcanite or gold denture can be refitted surely a denture that cost many times as much should not have to be scrapped, if it becomes sprung or if the patient's mouth changes slightly. But this has happened with the continuous gum denture many times and has been the cause of no small amount of trouble between the dentist and his patient. The dentist should not be held to blame for an accident to the denture; neither is it his fault that the mouth changes; but the patient argues from another point of view. He paid a high fee for a service that did not last and therefore was not satisfactory. Situations of this kind are unpleasant, to say the least, and often lead to controversies of an embarrassing character.

My technic for refitting a continuous gum denture, the importance of which I am sure you will appreciate if you have had any experience in this work, is as follows:

An impression is taken in the ill-fitting denture with thin plaster and a stone cast is poured. Before separating, the cast and denture are mounted in an articulator having an incisal guide pin. The mounting is accomplished by pouring soft plaster on the lower bow of the articulator, building it up to a little

*Presented as a clinic at the Sixty-Ninth Annual Session of the American Dental Association, Detroit, Mich., Oct. 28, 1927.

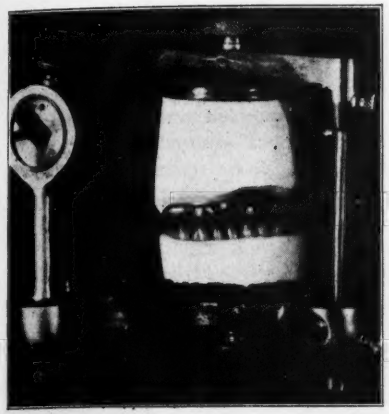


Fig. 1.—Denture to be refitted, mounted in articulator.

less than half way and leveling off the top, then carefully centering and seating the teeth of the denture in the plaster

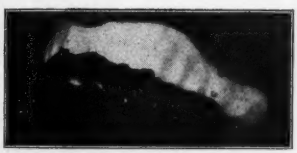


Fig. 2.—Teeth of ill-fitting denture coated with wax.

to the full depth of the cusps and incisal edges. The operation is completed by pouring more plaster on the top of

Fig. 3.—Lingual view of denture shown in Figure 2.

the cast, which has had a coating of shellac, building it up to engage the upper bow of the articulator (Fig. 1).

Fig. 4.—Denture submerged in hydrofluoric acid.

After the plaster has hardened, the cast is removed from the articulator and the

Fig. 5.—Porcelain etched away.

denture and cast are separated. The cast is mounted in plaster in the lower

Fig. 6.—Lingual view of denture shown in Figure 5.

half of a vulcanizing flask and set aside for the time being. The teeth of the ill-fitting denture are now given a coating of black carding wax (Figs. 2 and 3). This wax is flowed on the teeth with a hot spatula, care being taken to cover thoroughly all surfaces of the teeth and allow the wax to extend onto the gum about 1 mm. The wax covered teeth and denture are now submerged in hydrofluoric acid (Fig. 4) and left until all the porcelain, except that covered with wax, is etched away (Figs. 5 and 6). The teeth may come away from the platinum base all attached together, or they may be separated, which is immaterial. The wax is washed from the teeth with hot water (Figs. 7 and 8), and, with a small stone, all the remaining low fusing porcelain is ground from around the necks of the teeth (Fig. 9), after which they are reseated in their respective places in the lower part of the articulator (Fig. 10).

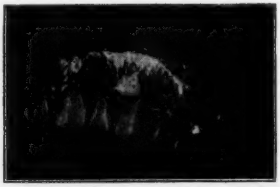


Fig. 7.—Wax washed from teeth.

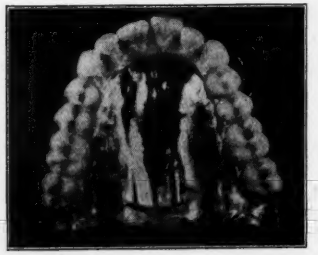


Fig. 8.—Lingual view of denture shown in Figure 7.

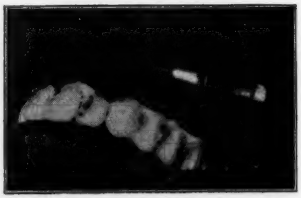


Fig. 9.—Low fusing porcelain being ground from around the teeth.

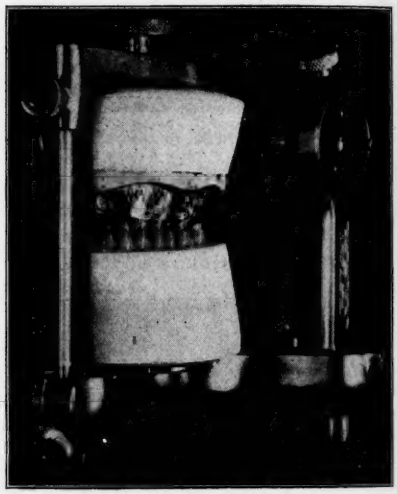


Fig. 10.—Teeth and platinum base reseated in articulator.

The platinum base is now placed on the stone cast, which was mounted in the vulcanizing flask, and swaged, annealed and reswaged until perfectly adapted to the new cast. The plate, mounted on the cast, is again placed in the articulator, and the teeth are attached to the refitted base by building porcelain on the platinum base, down to and around the necks of the teeth, according to the technic previously described.[1]

1. Howard, J. L.: Controlling Warpage in Continuous Gum Dentures, J. A. D. A., 14: 959 (June) 1927.

This refitting technic is very simple and, if intelligently employed, may prove extremely valuable at times in helping solve difficult problems. It is just another step toward placing continuous gum denture service on a practical basis, and I firmly believe that the day will come when this type of work will cease to be a curiosity to the dentist and a luxury to the patient, but will find a place in the practice of every progressive prosthetist throughout the land.

This is an age of rapid progress, in which people are demanding better things in every line of endeavor. Are we going to keep pace with the times and offer our patrons something a little better each year, hold out to them something a little in advance of their demands, or are we just going to drift along until we are swept aside by the current of progress, to become water logged driftwood?

We as a profession are great procrastinators. We deceive ourselves into believing that we haven't time to study or experiment. We use makeshift methods, substitutes and imitations, pacifying our consciences with good resolutions. If our efforts are not always crowned with success, we are too apt to become discouraged and give up. We forget that some of the best things in principle are often the most difficult to put into practice. This has been true with the porcelain gum denture. The basic principle was right or it would not have endured for over a century and a half, and if my prediction of the future practicability and popularity of the continuous gum denture does materialize, it will not be because of the efforts of any one person, but will be the combined result of years of study and research by a few persistent, progressive, men with high ideals, working for the thing they know is right in principle, and never content until this dream is realized in its application to practice.

RATIONAL MINOR ORAL SURGERY AS RELATED TO ORTHODONTIA*

By EARLE H. THOMAS, M.D., D.D.S., LL.B., Chicago, Ill.

THE duty and the pride of the truly conscientious professional man is to render his patient the best service possible, and to accomplish this result, the orthodontist often asks for the cooperation of the oral surgeon. I shall attempt to bring to your attention a few phases of oral surgery which can sometimes be of assistance to the marvelous work being done in the field of orthodontia.

*Read before the Section on Orthodontia at the Midwinter Clinic of the Chicago Dental Society, Jan. 25, 1928.

ELONGATED FRENUM

The frenum of the upper lip is a dense mass of fibrous tissue originating in the muscular tissue of the lip and normally terminating in an attachment

to the labial surface of the bone a short distance above the gingival border. Sometimes, this bony attachment extends down almost to the gingival border, but such a condition does not call for operation unless there is interference with the free movement of the lip.

However, it frequently occurs that the frenum extends between the central incisors underneath the gum tissue and terminates lingually of them in the papilla at the anterior termination of the median raphé of the palate, and overlying the anterior palatine canal. When traction is exerted by pulling the lip upward in such a case, one can see that the fibrous frenum causes a movement of the tissue located between, and lingually to, the teeth. Such a condition will cause the central incisors to be separated during and after eruption, and even if brought into perfect relationship, they will often separate again as soon as the retaining appliance is removed, owing to the expansive force of the compressed fibrous frenum.

Obviously, in such a case, an operation should be performed which will remove the fibrous tissue from its attachment between and lingually to the central incisors and replace it on the labial surface above the gingival border, where it belongs. I have devised a technic for such an operation which preserves the normal shape of the free margin of the gum tissue around each central incisor so that, when the teeth are brought together, the gum papilla will close the interproximal space up to the contact point,

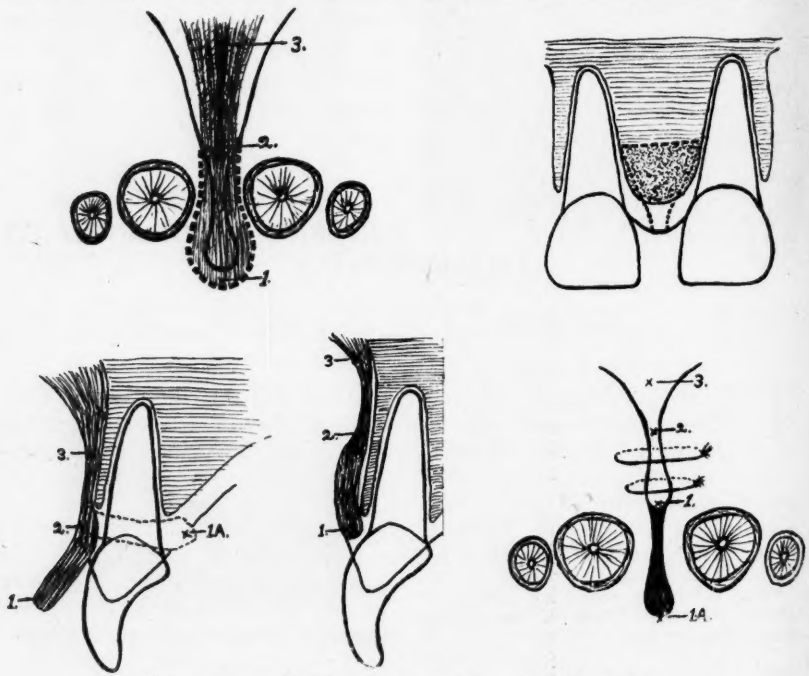


Fig. 1.—Removal of frenum preserving overlying gum tissue.

instead of leaving a triangular space void of tissue. This is accomplished by having the two labial incisions converge until they join together or at least only a narrow strip of gum is left between them as they pass through the space between the central incisors, the incisions spreading out underneath the gum tissue sufficiently to include all of the fibrous frenum. Also, the bone which was in contact with the frenum between

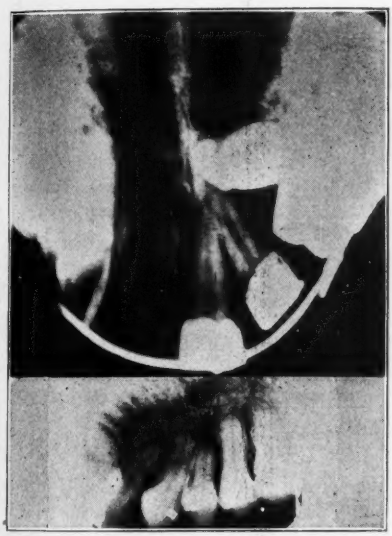


Fig. 2.—Impacted upper cuspid in a woman aged 27. The uncovered, overlying bone was removed and brought into position by the orthodontist in one year.

the central incisors is freshened, and the space that was previously occupied by the frenum subsequently fills up with normal bone. (Fig. 1.)

IMPACTED UPPER CUSPIDS

It is rarely necessary to remove impacted upper cuspids in a child. Even if they are lying in the palate horizontally or at a greater angle from normal, room can be made for them and they can be brought down into normal position. This can be facilitated by the oral surgeon's removing the soft and bony tissue over them, not only sufficiently to expose a portion of the crown but also to the extent of exposing practically all of the crown, and also removing all of the bony tissue in the path which the tooth must take in being moved to its normal position.

Packing gauze behind the exposed crown of the tooth will rapidly force the crown out sufficiently for the orthodontist to obtain an attachment to it without drilling a hole in the crown, as described by Frederick B. Noyes.

One must be sure, before attempting to operate, to localize accurately the crown of the tooth by roentgen-ray pictures, because some of these teeth must be exposed labially instead of lingually. (Fig. 2.)

IMPACTED THIRD MOLARS

The first thing to consider in regard to supposedly impacted third molars is whether they are really impacted or not, and this can be determined only by competent interpretation of roentgen-ray pictures taken with a definite and correct technic. Normally erupting third molars may be shown in almost a horizontally impacted position on roentgen-ray pictures made at an incorrect angle.

If the tooth is actually impacted, when should it be removed and when should it be left *in situ?* I would here like to express my adherence to the principle that all impacted or malposed teeth should either be brought into normal position or be removed. That is a principle, not an inflexible rule—you know we are supposed to use our brains once in a while.

Why should we be so radical, if such a principle should be called radical? To answer this question fully would require

a paper in itself, but we cannot ignore the many serious conditions that can result from the presence of impacted teeth. Some of these are: neuralgias, which, when once started, are not always relieved by the subsequent removal of the tooth; mental symptoms, headache, some types of insanity; reflex symptoms in other portions of body: eye, ear, stomach, etc.; crowding of other teeth out of alinement; absorption of roots of adjoining teeth, with their loss; after exposure to saliva or to the apex of a pulpless tooth, infection and its local effects, as well as its action as a focus producing infectious conditions elsewhere in body; development of large cysts around their crowns, resulting in loss of adjacent teeth and destruction of large areas of bone.

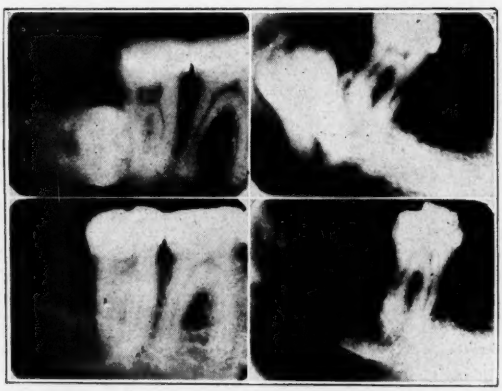


Fig. 3.—Two impacted lower third molars removed without disturbing the second molars.

And is it so radical to advise removal of impacted teeth at once when experience shows that it becomes absolutely necessary to remove practically all of them some time later, after damage has resulted? Even after jaws are edentulous and dentures are placed in the mouth, impacted teeth that have been left in will, most of them, cause trouble necessitating their removal. Now, if it becomes necessary to remove practically all of them some time in life, the logical thing to do is to remove them as soon as it is known that they are impacted and before they have caused trouble: prevention is the watchword. Furthermore, the earlier in life they are removed, the less difficult is the operation and the less the postoperative troubles. The removal of an impacted tooth in a young person with soft cancellous bone and with a good blood supply will often cause practically no postoperative reaction; whereas, in an older person, with dense sclerotic bone, the same operation may be very formidable.

If done in a competent manner, the removal of an impacted third molar is not the terrible operation that some dentists seem to think. Many are removed with practically no postoperative pain or swelling, and healing occurs as in an ordinary extraction. Furthermore, if the operation is properly done, there is absolutely no injury to the second molar. Correct technic always leaves a protective gum flap around the distal margin of the second molar.

Another thing: some dentists look at the roentgenogram in a very difficult impaction and advise the removal of the second molar because, otherwise, they think it impossible to remove the third molar. Rarely indeed does the second molar need to be sacrificed for this reason, and such advice should not be given without consultation with the oral surgeon who is to perform the operation. It may be of interest to know that when both an impacted third and an infected second molar have to be removed at the same operation, most oral surgeons remove the impacted third molar first and then the second molar. (Fig. 3.)

If an impacted third molar has become exposed to the saliva, it is always infected deep under the gum and should most certainly to removed as soon as possible, not only to prevent systemic effects, but also to preserve the second molar in a healthy condition. Furthermore, a third molar that is fully erupted but which is crowded against the throat tissue and the cheek tissue next to the ramus of the mandible should, in most instances, be removed, because there is practically always infection under the gum tissue around such a tooth, and this is a frequent source of focal infection. Furthermore, these are frequent sites for the development of cancer in older patients, and no such source of chronic irritation should ever be allowed to remain in the mouth.

From the foregoing, you will understand why I disapprove of cutting away gum tissue flaps over erupting third molars. If the tooth is in such a position as to require this procedure, it should be removed.

OTHER IMPACTED AND MALPOSED TEETH

Many other teeth may become impacted or may erupt in abnormal position. These should either be brought into proper position or removed. Bringing them into proper position can be aided by methods similar to those described under impacted upper cuspids.

SUPERNUMERARY TEETH

Supernumerary teeth should practically always be removed and especially so if interfering with the eruption of normal teeth.

PULPLESS TEETH

When a deciduous tooth loses its pulp and becomes abscessed, let us consider the patient's health and life more important than the possible resulting malocclusion, and let us always advise removal of such a tooth. One glance at the statistics of heart disease in children ought to be sufficient to determine our decision in such cases, and all of this heart disease is caused by infection getting into the heart through the blood stream from somewhere. Furthermore, when pulpless teeth in children become abscessed, the infection often has a tendency to burrow deep into the bone, causing serious cases of necrosis, resulting in facial deformity.

ROENTGENOGRAMS

No orthodontist worthy of the name should start to treat a case without full mouth roentgenograms taken at correct angles. One never knows what may be found in such a set of films, and the information may materially influence the mode of treatment.

OTHER CONDITIONS

I should like to discuss a few other phases of oral surgery that would be of interest to the orthodontist, but time does not permit. Of especial interest would be some of the plastic operations that are possible on both the bony and the soft tissues of the mouth, face and jaws.

ANESTHETIC

In all operations about the mouth, the condition of the patient permitting, the anesthestic of choice always depends on the preference and ability of the operator.

DISCUSSION

F. E. Haberle, Chicago, Ill.: It has been my observation that the discussion of papers pertaining to dental subjects usually follows one or more of three forms. These are, disagreement or argument with regard to some of the ideas expressed, agreement or commendation of the views which have been set forth or elaboration of the subject matter presented or of some of its phases. Anything that I may say must come under the latter two forms; namely, agreement and elaboration. A condition of the labial frenum has been described in which its fibers extend between the upper central incisors, terminating lingually to them and causing their separation. This is a condition in which the oral surgeon's cooperation is necessary. However, this condition is comparatively rare. Too many frenums are being operated on. To many, the separation of these teeth in every instance denotes the necessity of clipping or dissecting out the frenum. Yet an examination in many of these operative cases would show no connection between the separation of the incisors and the frenum as its cause. The purpose of the labial frenum is to hold the upper lip down. In distoclusion cases, which are characterized by what the laity call a protruding upper jaw, we find a short functionless upper lip, with frequent separation of the upper incisors. We see cases of this type and of others also in which the frenum has been operated on. How may we expect the already underdeveloped upper lip to perform its function of covering the upper anterior teeth with a frenum which has been operated on? Supernumerary teeth are frequently the direct cause of malocclusion. They occur most often in the anterior portion of the maxilla. They may or may not erupt. In either case, they may, by their presence, deflect the teeth from their normal positions or cause failure of eruption or absorption. It is well to suspect a supernumerary tooth when teeth are found out of the normal position, or are missing. As a matter of principle, these teeth should be removed. Dr. Thomas has laid down the principle that all impacted teeth should be brought into position or be removed. This I believe to be correct. There is a tendency to minimize the possibilities and dangers of violation of this principle. Impacted teeth, either normal or supernumerary, may, by their presence cause much harm to, or loss of, teeth adjacent to them. By the pressure exerted by them in attempting to erupt or in shifting about, this damage or loss is made possible. Yet we are told, in many cases, to let these teeth alone, as they can do no harm. Crowded and impacted third molars, by the force exerted in their efforts to erupt, may destroy a good occlusion which may have been due to the work of nature or to the efforts of the orthodontist. After arranging the teeth and jaws in their proper relations, it is rather discouraging to find, in later years, that a crowded or impacted third molar has ruined an otherwise fine result.

A GREAT ORGANIZER AND SCIENTIFIC MAN

By D. M. CATTELL, A.M., D. D.S., San Francisco, Calif.

WE do not realize the greatness of some of the men belonging to the generation just past, men who belong to our profession, yet lent themselves to Europe for practice and research. W. D. Miller was one of the greatest. He was born in this country, studied both here and in Europe, then gave his talents to the profession, but practiced abroad. At the time of his death, he was returning to this country to finish a great work in science, incidentally to become the dean of the dental department of the University of Michigan. In looking over the many obituaries written at the time of his death, in July, 1907, I find several which give fairly good reports of his life. The *Dental Cosmos*, the *Dental Review*, *Dental Summary*, the *Dental Digest* and the *Dental Register* all had good reports.

I have thought it well to republish the account of his activities on this the seventy-fifth anniversary of his birth, so that the present generation of professional men might know and not forget those gone before who left such wonderful records. He was to Europe what Black was to America.

The following is taken from the obituary in the *Dental Cosmos* at the time of Dr. Miller's death:

PROFESSOR W. D. MILLER

Died, at 1 o'clock Saturday afternoon, July 27th, at the Newark, Ohio, Hospital, from an attack of heart failure following an operation for appendicitis, WILLOUGHBY DAYTON MILLER, Ph.D., D.D.S., M.D., Sc.D.

The brief press announcement of the sudden and unexpected death of Dr. Miller came as a shock to all who read it a few weeks ago, and with the larger publication of the fact among his professional colleagues the crushing weight of this irreparable loss will be felt throughout the entire world.

In the zenith of his career, with judgment ripened by experience, with skill and abilities trained by long years of study and laboratory investigation, and with energies and enthusiasm renewed by reason of his return to his native land, with a fresh and fruitful field for his activities, the promise of his enlarged usefulness and of higher service to his profession and to humanity seemed bright and sure for many years yet to come; the record of the past seemed to be the earnest of the future. But like lightning from a clear summer sky has come the word, "It is finished," and Miller has answered the summons of the Eternal.

Let us record what we can of this life—of a man so much one of us, and yet, by reason of his wonderful character and attainments, so much alone in the position he had won for himself.

Born August 1, 1853, near Alexandria, Ohio, Dr. Miller received his early education in the public schools of Newark in that state. He was always a bright pupil, studious and quick of apprehension, and an infallible prize-taker. He attended the University of Michigan at Ann Arbor from 1870 to 1875, and was graduated there as B.A., "with eminent rank." During the winter of 1875-76 he visited the University of Edinburgh to attend chiefly the lectures of Tait and Crum Brown on mathematics, physics, and chemistry, and received honorable mention for work in his laboratory and the prize offered by Professor Tait for the best essay on a specified subject. In 1876 he heard the lectures of Von Helmholz, Kirchhof, Wangerin, etc., at the University of Berlin, but was interrupted in this work by illness,

which eventually led to his taking up the study of dentistry—for which purpose he returned to America and matriculated at the Pennsylvania College of Dental Surgery for the session of 1877-78.

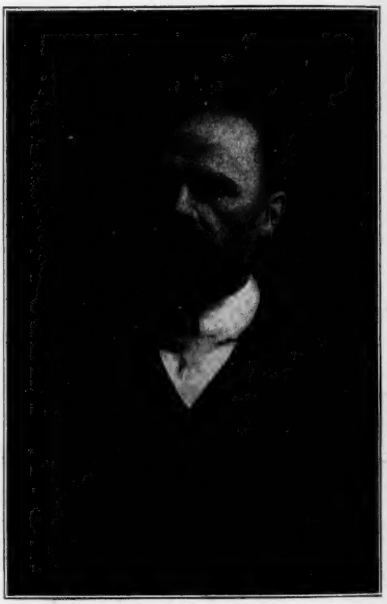
The circumstances which led Dr. Miller to the choice of dentistry as a profession instead of a career in science arose naturally out of the conditions surrounding him during his period of attendance upon lectures at the University of Berlin. At that time he formed the acquaintance of Dr. N. S. Jenkins of Dresden and through him met the late Dr. Frank P. Abbot, one of the pioneer American dental practitioners in Europe. A mutual interest ensued which led Dr. Miller to seriously consider the question of adopting dentistry as his life-work—a tendency further developed by a conference with Prof. James Truman, then practicing in Hanover, who advised him to engage in dental study, not only from the standpoint of its desirability as a life-work, but especially because of the need in dentistry of men with the natural aptitudes and the scientific training, particularly in chemistry and physics, such as Dr. Miller possessed; and most fortunately for our profession this advice was favorably received and carried into effect.

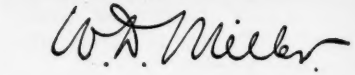
In the class of 1877 at the Pennsylvania College of Dental Surgery, Miller instantly attained pre-eminence and excited the admiration of teachers and students alike by his learning, his quickness of understanding, his studious habits, and his lovable personality. In the spring of 1878, the Department of Dentistry of the University of Pennsylvania having been organized, he transferred his matriculation to that institution, from which he was graduated in the spring of 1879 as D.D.S., receiving the prize for the best essay on "Conservative Treatment of the Dental Pulp." Upon graduation he returned to Germany and began the practice of dentistry with Dr. F. P. Abbot, at the same time continuing his studies at the University of Berlin.

On October 26, 1879, he married Miss Caroline Abbot, daughter of Dr. F. P. Abbot, his professional associate in dental practice.

In 1884 he was made professor of operative dentistry at the newly founded Dental Department of the University of Berlin, being the first American to receive the honor of a professorial appointment in a German university. In 1885 he received the honorary degree of Ph.D. from the University of Michigan. In 1887 he attained the degree of M.D. at the University of Berlin with the predicate *Magna cum laude*. In 1894 he was made Professor Extraordinarius in the medical faculty of the University of Berlin, and about the same period was made a State Examiner for Dentistry in Berlin.

In June, 1902, the University of Pennsylvania awarded to him the highest scientific distinction within its gift by conferring upon him its honorary degree of Doctor of Science. On September 28th of last year the





German Emperor in a personal letter conferred upon him the title of Geheim Medizinalrat, or Privy Medical Councilor, in recognition of his scientific attainments and the valuable character of his services to science and education.

Dr. Miller was president of the Central Verein Deutscher Zahnärzte, which corresponds to our National Dental Association; of the Unterstützungskasse für Deutsche Zahnärzte, an institution for the support of impecunious colleagues and their families;

and of the Fédération Dentaire Internationale, and had recently been elected to the deanship of the College of Dentistry of the University of Michigan.

He was an honorary member of many dental societies both in Europe and America, and wherever dentistry is known and practiced he was universally recognized as the acknowledged leader of our profession. He was a voluminous writer upon topics in nearly all departments of dental science and its art. It is possible that others may have exceeded him in quantity of literary output, but certain it is that none has produced such a volume of literary work of anything like the same scientific and practical importance. The appended list of his principal contributions will give some idea of the nature of his studies and their versatile character, but even a close and careful reading of them all would by no means convey an adequate idea of the painstaking labor involved in the preliminary preparation of the data involved. As a single example it may be mentioned that in his studies on the "Wasting of Tooth Tissues" which appeared in the early issues of the DENTAL COSMOS for the current year, he informed the writer last summer in Berlin that the preparation of the specimens required over ten thousand hours of attention and work to artificially reproduce this commonly observed defect and to establish the point that it could be produced by the mechanical action of the brush and tooth-powder.

The same painstaking, patient, and persistent search for the truth characterized all of his work. His work on the etiology of dental caries is a classic which remains successfully unchallenged today as the final authority upon the subject which it covers. It was this work which at once brought him into prominence before the scientific world and secured him a position among investigators of the first rank, with a status in the dental profession equivalent to that enjoyed by Pasteur and Koch in medical science.

The luster of his fame as a scientific researcher needs no further illumination than that afforded by his recorded works, and it is in that rôle that he is best known; but our sketch of his life and character would be sadly incomplete without reference to certain other of his characteristic attributes—one of the most important of which was his genius for organization. In the conduct of dental society work and in dealing with all the intricacies of professional relationship his logical mind and his tact, coupled with his winning personality, eminently fitted him for leadership. Much of the solidarity of the dental professional organization in Germany owes its high development to the influence, both indirect and personal, of Miller, and in an international way his earnest efforts through the agency of the International Dental Federation, as its presiding officer and guiding spirit, have done a wonderful work for good in bringing the dental profession in all countries into more intelligent and harmonious relationship. He was the great leader, and to witness his tactful and graceful direction of a cosmopolitan assemblage of dentists, conducting his work as president with equal facility in three languages, was indeed an inspiration.

These are, however, the public and external features of the man that impressed all who had knowledge of him or the opportunity to observe him in official relations, but they are only imperfect indications of the man himself. The writer of this counts it as one of the privileges of his life that he knew and loved Miller for thirty years, and in all that time had never met anyone who had any other feeling for him than honest affection. It was that which he himself felt for all, and he compelled it in all. With a soul the embodiment of truth, with the tenderness of a woman and the nature and simplicity of a child, he was in harmony with all of God's creatures,—helpful, sympathetic, generous, the idol of his family and his friends,—and toward all his attitude seemed to be a practical realization of the truth that "Liebeerwecket gegenliebe," so that his life was a happy one, and measured by all standards was a success.

Though suddenly brought face to face with the end, he met the issue with that calm courage which characterizes the hero. When the attack of appendicitis came on, it was at first not deemed necessary to operate; in fact, it was his wish upon his wife's account to postpone it if possible. In a few days the attack became more acute and he was taken to the hospital at Newark, Ohio. The operation took place on the 22nd of July, and was an exceedingly serious one, gangrene having set in. For days he made an heroic struggle for life, enduring intensely uncomfortable positions for long periods in

order that the wound might heal under the best possible conditions. No word of complaint passed his lips. He was firmly determined to get well, and until the very last did not know that he was to go. His devoted wife reached him the day after the operation. The wound was successfully cleaned and had begun to heal nicely; however, in spite of all efforts, on the evening of Friday, July 26th, he became unconscious, and at 1 o'clock on the afternoon of the following day he passed away.

The fact is very impressive that up to the very last he gave evidence of firm belief in the life hereafter. Neither his occupation nor the atmosphere of skepticism in which he lived had shaken his Christian faith.

His remains were interred in the family burial lot at Alexandria, Ohio.

He is survived by his widow and three children—a son and two daughters.

* * *

"In Memoriam" Resolutions

The following resolutions were presented by Hofrat Dr. N. S. Jenkins and unanimously adopted by the "W. D. Miller Dental Club," Berlin, Germany, at a special meeting held August 6th:

Whereas, Geheim Medizinalrat Professor Dr. Willoughby D. Miller, the great scientist and beloved friend for whom our club was named, has been removed by death, therefore,

Resolved, That in common with all the members of our profession we deeply mourn our irreparable loss; and

Resolved, That as we were united to him not only by the admiration and respect which his scientific work spontaneously evolved, but also by the ties of warm personal friendship, we hereby pledge ourselves to cherish forever the memory of his example, which shall inspire us to higher devotion to our profession, to broader charity, to nobler living, and to deeper compassion toward suffering humanity, whom he served so well and so unselfishly.

Geo. O. Webster, *President,*
E. D. Barrows, *Secretary.*

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C. N. JOHNSON, Editor

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Editorials

OUR STATE SOCIETIES

It is of the utmost importance that the parent body of the American Dental Association foster and support in every way possible the various state organizations which go to make up the components of our Association. The very life force of our great organization is embodied in these societies. The activities of the state groups are reflected in the central body, and this body could not function long without the sustaining influence of the components.

Manifestly, therefore, it is essential for the welfare of the entire organization that there be the closest connection between the state groups and the central body. Each needs the other, and all the aid given the components by the central group reflects back to the benefit of the whole organization.

It would be well, if it were possible, to have a representative from the central office attend every state meeting. It would accom-

plish two things: it would prove that the organization had a vital interest (which it has) in every one of its components, and it would also add to the interest of the state meetings.

While, on account of the great distances in this country and the overlapping of dates of the state meetings, it does not seem possible at this time to send a representative to every component meeting, a great deal has really been done in recent years to cement the ties between the state societies and the central organization. The respective presidents of the American Dental Association have traveled far and wide in an endeavor to carry the message of organization to the outlying groups, and there have been other agencies active in this work, notably the Bureau of Dental Health Education, whose supervisor has visited nearly thirty states—some of them more than once—in an effort to show the interest which the central organization has in the component groups.

Since his incumbency, our President, Dr. Volland, has spent much of his time attending meetings, and in every way possible has endeavored to link up the various state groups in a united effort for the benefit of the organization as a whole.

A most encouraging aspect of the situation at the present time is the evident interest shown in their society by the members of each state organization. It has been the good fortune of the Editor to visit quite a number of the state meetings in recent months, and it was the consensus of opinion in every instance that the 1928 meeting of the society was the best ever held. There has been apparent a vital force at work tending to an increasing interest in association activities, which augurs well for the future of organized dentistry, and all that is needed to maintain the pace already set is for each individual member to devote himself unselfishly to the best interests of the profession, and for the closest cooperation between the parent body of the American Dental Association and the various components as represented by the state societies.

These societies should realize that the central office is being maintained largely for the purpose of serving the components, and while, of course, there must be a limit to the character of

service dispensed, it is the intent of the staff in the office to render every aid possible to the various state organizations.

Much benefit is resulting from the state officers' conference held for the past two years, and as these conferences are convened annually, the extent of good that will be accomplished thereby is difficult to overestimate.

PREVENTION

Prevention! The god before whom all of us should bow — the deliverer — the savior — the emancipator. The deity at whose shrine are worshiping today all the pale-faced and plodding scientists, large eyed and serious; bending over vats and nauseous mixtures; living in smells abominable; facing dangers innumerable; laughing in ecstacy when a fact is found; smiling with philosophy when a failure is recorded; bravely picking up the tangled threads again and weaving the warp and woof of a new idea; going back over the same old beaten path, hard trodden with the tramp of a thousand tired feet, seeking a new byway with the hope of getting a ray of light; baffled at many a turn, but groping with eager anxious eye to find the right road; spelling defeat and success—success and defeat—and accepting each with equal grace and merely as part of the hour's work; wan and wearied with the vigils of night and day; buoyed up with the vision of what may be just beyond; sleeping on a pillowed dream of emancipated millions; hoping against hope with an eye only on the goal; pressing onward when the road is rough and the path hedged about with briers; reaching anxiously out for the unattainable and sometimes touching it with the finger tips—the thing that was impossible yesterday made a glorious reality today; daubed over with the slime of germination, and watching with straining eye the miracle of birth and growth, of decay and death; searching for cause and effect and more interested in the cause than in the effect; sometimes lost in the labyrinth of circumstance and chance, but always eagerly feeling the way back to fundamental fact; looking only

and forever for the truth and fervently following it no matter where it leads; blending all the human limitations with the essence of divinity—the frailty of the finite mind with the sublimity and grandeur of eternal truth.

Man is hedged about by the mortality of his nature, but sometimes he breaks the bonds and soars aloft till he gets a glimpse of infinity, and in the tiny atom so small that it cannot be seen or felt, he reads with prescient eye the story of all of life. And as he looks, he sees in vast array the armies of disease—the vicious hosts of dread despair that sweep away the lives of prattling babes and leave the aching hearts of mothers palsied, numb and drear—but as he looks again he sees a lambent light whose rays lay low the vanguards of disease, and when the hosts come on and on, this light sweeps back their fierce attack, and babes may laugh and mothers' hearts grow glad.

And thus prevention's precious reign is ushered in, and hope is high, and cheer and joy abound; and in that day when this rare prince shall reign throughout the earth, the sons of men may tune their hearts to happiness and joy.

AMERICAN DENTAL ASSOCIATION CHEMIST

Announcement is made that the American Dental Association has obtained the services of S. M. Gordon, Ph.D., as Association chemist. This is in accordance with the recommendations of the House of Delegates, on suggestion of the retiring President, Dr. Banzhaf, whereby a cooperative arrangement was made with the American Medical Association.

For the past five months, Dr. Gordon has been receiving a course of training in the investigation of medicinal agents, thus gaining the benefit of the experience of the American Medical Association chemical laboratory. Beginning August 1, Dr. Gordon will engage in the work of investigating products of dental interest, such as the products advertised extensively to the public, and also the proprie-

taries sold to the dental profession. From time to time, the reports will be published in THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION. There is also being contemplated the formation of a council or commission composed of representative clinicians in dentistry and having the cooperation of outstanding men in the sciences connected with dentistry, such as bacteriology, pharmacology, medicine and ceramic chemistry. This council would round out the reports of the chemist so that the dental evidence could also be subjected to critical comment. Products sold to the dental profession will be passed on according to rules, and either accepted for an approved list of dental products, or rejected. The products imposed on the public will be discussed in THE JOURNAL, and, it is expected, will be copied or abstracted widely elsewhere.

Owing to the large amount of work involved (as it must be thoroughly checked), the Association chemist would be overwhelmed with work if investigations were done for individuals. He will therefore examine *only those products which are of general interest to the dental profession* (i. e., widely advertised), and concerning which a relatively large number of inquiries have been received, and, in addition, the products submitted to the council for which the council requests investigation. As the files of the chemist increase, the members of the Association will, it is hoped, find them a ready source of information.

Dr. Gordon graduated from Tufts College, receiving, a B.Sc. degree in chemistry. He then took a master's degree from the State University of Iowa, and the degree of doctor of philosophy from the University of Wisconsin. In addition, he has pursued studies in chemistry at Institute Agronomique, Paris, and at Harvard. Before accepting employment with the American Dental Association, he was National Research Council Fellow in the Biological Sciences.

BUREAU OF DENTAL HEALTH EDUCATION

IMMUNIZING MOUTH TISSUE TO INFECTION BY CORRECT STIMULATION WITH THE TOOTHBRUSH*

By W. J. CHARTERS, D.D.S., Des Moines, Iowa

IN every vital health movement today, the real slogan is "prevention." Without a doubt, "an ounce of prevention is worth a pound of cure," and nowhere else does that truth show up more forcibly in the human body than in the care of the teeth. Now how can we dentists feel that we have done our full duty in preventive dentistry when we consider the enormous number of adults who have regularly made their semi-annual visits to the dentists, who have brushed their teeth the prescribed number of times each day, and who have suddenly awakened to the fact that they have well developed cases of pyorrhea and infected teeth? In view of this condition, it is hardly surprising that some observing critics find fault with the whole dental procedure and decry all attempts to teach patients how to keep gum tissues and teeth healthy. Whose is the fault? And can something be done to insure a correct preventive technic?

In my own practice, in the examination of the mouths of fifty new patients, I found that disease was not due to the disuse of the toothbrush but to its misuse. If we dentists devoted 50 per cent of our time now spent in selling restorative dentistry to the teaching of a system of home care for the gums and teeth, we would raise our standing, as members of the dental profession, in the minds of the laity. Such teaching would do much to insure the general good health of our patients and to give us the personal satisfaction of seeing pink resistive gum tissue and spotless teeth whose condition we have helped to procure through our advice. The blame for the astounding prevalence of infected teeth and pyorrhea among the adults who have been regular patients of dentists year after year must be placed squarely on the dentists themselves.

Particularly do I think that all dentists owe a responsibility to the children in this matter of prevention. In many of our schools today, the teacher takes cognizance of the importance of care of the teeth when she gives credit for tooth brushing among the "health chores." In many schools, too, the school nurse examines the children's teeth and recommends visits to the dentist when she observes marked teeth defects. Cannot the dental profession take advantage of this school interest in the care of the teeth and direct the interest into teaching the correct method of brushing and stimulation? The correct method is difficult for the beginner and cannot be accomplished without personal demonstrations, but it can be taught suc-

*The papers of Drs. Charters, Pettibone and Bricker were presented as a symposium on "Methods of Mouth Brushing."

*Read before the Section on Mouth Hygiene and Preventive Dentistry at the Sixty-Ninth Annual Session of the American Dental Association, Detroit, Mich., Oct. 27, 1927.

cessfully. There is no use merely to insist in the schools on perfunctory brushing, when the results of such brushing will be nil in after life. Let us try to save the children from finding themselves in a generation of adults which, like our own generation, may be 80 per cent afflicted with pyorrhea. Why should we not place on the curriculum of our schools instruction in the correct method of manipulating the toothbrush, emphasizing the health value of proper care of the teeth at least to the same degree that we recognize physical education work in gymnasiums and on playgrounds? Every dentist who feels a responsibility for the health of his community should feel a challenge in this need for health education work in the schools.

Now what can be done to teach correct preventive technic?

In scientifically teaching the use of the toothbrush for the last fifteen years, I have proved to myself, and many others, that to teach a patient how to wield a toothbrush correctly, so as to stimulate the gum margin all around each tooth, especially in the interdental spaces, is a hard and tedious task. You will readily understand that in doing this, you cannot possibly avoid causing friction on four surfaces of the teeth, with the exception of extremely concave approximal surfaces and a small portion of the surface lying immediately below the contact surface. However, the harassing treatment that the acid-forming bacteria receive at these places is unwelcome and will go as far as to prevent 95 per cent activeness of this treacherous tooth-destroying agent.

My experience in experimenting with dental floss over a long period of time has shown that it is impossible to produce resistive gum tissue by its use. It is not my intention to discourage the use of floss. I only wish to convey to you what it will not do in my hands, and I wish to make the statement at this time that every suggestion given has been tried and proved by me.

Next to the toothbrush in usefulness is the instrument for stimulation of gum margin. This instrument can be made of wood, bone, reinforced rubber or metal. Metal (silver) and orangewood are the materials that I am using at present. The size and shape of this instrument depends on the interdental conditions. Almost all individual mouths will require one or more different sizes. The size is determined by the condition of the alveolar process and the soft tissues. The instrument is made to enter far enough between the teeth that the points may be felt with the tongue, and, in this way, pressure is created on the gum margin with the aid of the contact where gum recession is not too pronounced.

In previous papers, I have mentioned the many systemic disturbances in which the patient has been benefited by the use of this technic, which I need not repeat, as the most of you are familiar with these claims.

Before I proceed with the explanation of my method of teaching the correct use of the brush, I may say that a pathologist who worked with me in a recent series of tests found that the bacteria taken from scrapings between the teeth of patients under instruction showed, after three weeks of correct brushing and stimulation, a reduction from 7,000,000,000 to 2,000,000.

The method employed in teaching a new patient is as follows:

At the first appointment, the patient brings two brushes. One is for home work and the other is labeled and left

in the office for demonstrating purposes. These lessons, which are given by a nurse, consume about fifteen minutes; ten minutes for personal brushing, using the brush to stimulate the gum margin around all the teeth, and five minutes for demonstration on models of teeth as to how, why and where to place the bristles.

On the second visit, the nurse does the stimulating but eliminates the work on models. Instead, she has the patient take the brush, and she proceeds to instruct him as to how to place and use the bristles only on the outside surface of one quarter of the teeth. To cover more surface than this in the first lesson would be confusing and the instructions would probably be forgotten. On each consecutive visit, another quarter of the tooth surface is taken, until the entire surface, both labial and lingual, has been taken care of. Appointments are made for every day, if possible, or every other day, and are continued until the patient is able to acquire results without instruction. This usually takes about four weeks. The mouth should be rinsed thoroughly after the brushing as the brush carries out little mucin. The use of the disclosing solution is very important as it reveals to the patient the surfaces he is missing.

A great deal has been said about the toothbrush carrying infection. I will admit that there would be cause for alarm if two people were using the same brush, but I am presuming that this is not the case; so I would suggest that you transfer most of the time consumed in warning or debating that the condition of the brush may be harmful to instructing the patient how to apply the brush correctly. Thus, more will be gained for both the dentist and patient.

The thorough drying of the brush after each brushing will also add to its cleanliness by discouraging the growth of any bacteria that escaped the flushing, because of their change of environment.

It is also good practice to wash the brush with soap two or three times a week in order to remove, by the detergent action of the soap, particles of the dentifrice used and other foreign matter imbedded in the tufts of the bristles at their base. This will materially add to the lifetime of the brush.

THE METHOD

Place the brush at right angles to the long axis of the teeth, then gently force the bristles between the teeth, being careful not to pierce the gums; that is, do not allow the points of the bristles to rest on the gums. With the bristles between the teeth, exert as much pressure as possible, giving the brush several slight rotary or vibratory movements, causing the sides of the bristles to come in contact with the gum margin, producing an ideal massage. Be careful not to make this movement sufficient to remove the bristles from between the teeth. After making three or four small circles, remove and replace in the same area. Make three or four applications in the same place. The reason for this is that the points of the bristles strike the labial, buccal and lingual surfaces, then slide into the interproximal spaces. Move the distance of one embrasure, and repeat the process, holding the sides of the bristles firmly on the gum margin. The V-shape space between the teeth assists in crowding the sides of the bristles against the gingiva. Where teeth are missing, we have to depend on our sense of touch to keep the proper pressure, with the sides of the bristles on the gum margin.

320 South Surety Bldg.

MOUTH BRUSHING*

By E. L. PETTIBONE, D.D.S., Cleveland, Ohio

AS this symposium and demonstration is given before the Section on Mouth Hygiene and Preventive Dentistry, it is logical to conclude that methods demonstrating mouth hygiene and aiding in prevention will be most acceptable. It is not my wish to insist on one particular method of brushing or to speak disparagingly of any other methods, especially those used to correct pathologic conditions. Rather is it my intention to emphasize the need of more thorough and universal teaching of toothbrushing. Therefore, I am presenting a method easy to teach, easy to learn, and qualified as a satisfactory form of oral prophylaxis.

This is an ancient, true and tried method, first used by us in 1909, when we began to teach mouth hygiene to school children and adults in the public schools in Cleveland. This method, which was adopted after thorough deliberation by our committee, working under the direction of the late W. G. Ebersole, has been carried by us to all parts of our state and by Ohioans to all parts of the world and to people in all walks of life. It has become pretty generally known as the "Ohio method," and may be described as follows:

Brush the teeth the way they grow. The upper teeth down, the lower teeth up. The brushing is started on teeth and gums on the upper left side of the jaw. The bristles of the brush, well above the gingival margin, are then brought downward with a sweeping, rotary movement of the brush obtained by the twisting of the wrist. The children are instructed to brush down and then bring the brush away from the teeth, raising the brush to the original position, and down again until they have brushed on the surface in this region ten times. Next, the anterior teeth are brushed ten times on the labial surface in the same manner. This procedure is then carried out the same number of times on the buccal side of those teeth on the right side. Next, the surface toward the tongue is brushed on the lingual side of the right upper posterior teeth, and on the lingual side of the anterior teeth, after which the posterior teeth on the right side are brushed. After the brushing of the lingual and buccal surfaces is completed, we brush forward ten times on the occlusal surfaces on the left side and the occlusal surfaces on the right side; this completing the prophylaxis of the upper teeth. We then direct the patient to start on the left lower buccal side and reverse the motion, brushing up on the lower teeth. This is followed out ten times in each position as indicated on the upper teeth. The patient is then told to take a glass of lukewarm water and force it between the teeth to rinse out thoroughly any remaining débris.

*Read before the Section on Mouth Hygiene and Preventive Dentistry at the Sixty-Ninth Annual Session of the American Dental Association, Detroit, Mich., Oct. 27, 1927.

In order to teach this method, or whatever method you can teach especially to children, more easily, I am introducing motion pictures taken by one of the small motion picture cameras that are so commonly used now, and the films of which can be so safely and easily shown wherever there is electric current.

When we first began to demonstrate mouth hygiene, we had the lantern slides taken out when we came to that part of the lecture relating to brushing, and the lecturer stood in front of the curtain and demonstrated the brushing in the glare of the lantern. This was quite effective, but it was very hard on the eyes of the lecturer. Then, we tried to use slides showing the method of brushing, but these did not seem so effective. So, wherever we could, we used regular motion picture films, and we literally wore out several of the "Toothache" films, the first dental films ever produced. The handicap in the use of the film was the cost of the operator's services, the cost of renting a machine and booth and the cost of transportation.

During the war, on our frequent and regular trips to the army camps, we also used charts demonstrating brushing. Lanterns, motion picture machines and charts were made use of, according to our location and type of building we had to work in. Later, we obtained an automatic lantern that was supposed to give the lecture and demonstrate the brushing, but that did not work out satisfactorily. Later, we tried to turn the lecturing over to the dental hygienists, but it was not always possible to do so.

Not only is it difficult to stand in front of a lantern and brush the teeth, and then stop to tell what we have done, but it is also embarrassing. After giving this demonstration to more than 100,000 people, I decided to try out one of the safe, convenient and handy motion picture machines, which are easy to manipulate, easy to operate and easy to transport, and the result, we believe, is much more satisfactory. The demonstration (the lesson) seems to be more effective than the old method. The films cost but $6, and we can demonstrate our own method of brushing before the camera, and run the picture while we explain the method.

When we have a portable "Vitaphone" to give the lecture, this method will be most effective.

WHAT TO TEACH THE PUBLIC REGARDING BRUSHING METHODS*

By FREDERICK A. BRICKER, D.D.S., Hollywood, Calif.

EVERYONE desires good-looking teeth, yet comparatively few realize that "good-looking" means well-brushed. The majority labor under the delusion that Nature gives us or does not give us good teeth, and that if one chances to belong to the latter group, there is nothing he can do about it except pay dental bills. How far this is from the truth is realized by every member of the dental profession.

Teeth, like healthy bodies, require daily exercise. In the case of bodies, the exercise may be golf or tennis; but, for teeth, there is only one health-giving sport, and that is brushing. If once we can arouse the interest in acquiring the correct stroke of the toothbrush that is nation-wide as regards the golf-stick, preventive dentistry will have earned its laurels.

Teeth are indeed little bodies; they have their nervous system, their circulatory system, their bone. The shine of the enamel is like the rose of the clear complexion — an indication of health. And the rosy gum is the healthy gum. This analogy makes a good basis for the teaching of correct brushing in the dentist's office. Unless we approach it from an interesting angle, we are liable to find ourselves against a dead wall; for the average person thinks he knows all about teeth. It is like saying to a grown man, "Now I am going to show you how to walk." His indignant exclamation needs little imagination. As to his teeth, didn't his mother teach him how to brush them, and hasn't he been doing it twice daily for years? This type of patient is at first more difficult to teach than the one to whom oral hygiene is an unknown quantity, for, with the latter, there is at least the appeal of novelty.

Every patient has his favorite sport. Find out what it is, and build an analogy upon it. Taking golf for an example, the dentist might make his approach with the friendly question: "What do you go round in?" If the score is low, the patient may be congratulated on his stroke, and asked if he swings his toothbrush as intelligently. If it is high, the patient will probably offer the information that he is new at the game, and his stroke needs some finishing touches. Again the analogy with the toothbrush may be drawn, and the correct method of brushing explained.

You cannot teach your patient how the bristles of the brush ought to feel by telling him as well as you can by brushing the patient's mouth for him, so that he knows by the sense of touch when the bristles are being placed correctly.

Because the desire for health is an inherent desire of man, and because, owing to the knowledge spread by public health education, infection and uncleanliness have come to be synonymous with dis-

*Read before the Section on Mouth Hygiene and Preventive Dentistry at the Sixty-Ninth Annual Session of the American Dental Association, Detroit, Mich., Oct. 27, 1927.

ease, the dentist who teaches preventive dentistry has the road partly broken for him. Then, too, he has his man, so to speak, "down"; for, according to tradition, the patient does not step out of the dental chair until he is told to. He has to listen.

The chief problem is to know the subject so thoroughly that we can answer every question intelligently on the spur of the moment. Certain questions are asked so frequently that they become tiresome or amusing unless we recognize in them a real opportunity for teaching preventive dentistry. These are: How stiff a brush shall I use? How hard should I brush my teeth? What are the first symptoms of pyorrhea? What is the best dentifrice to use?

The first question gives us an excellent chance to teach oral circulation. Personally, I teach general circulation as a foundation and then show that the oral circulation is similar to the general. By using this analogy, it is usually possible to give the patient a clear mental picture of the reasons for brushing the mouth.

From this point, we proceed to answer the second question. Brushing should be as vigorous as is possible without causing pain or discomfort. Up to that point, it stimulates circulation; beyond that point, it irritates. All the stimulation possible without irritation is the desired end.

The first symptoms of pyorrhea which the patient will notice are inflamed and bleeding gums, sensitiveness of the gums to the brush and, later, looseness of the teeth and tenderness when he bites on the teeth.

Every dentist probably has his own point of view regarding the best dentifrice, and we all know that there are many good dentifrices on the market. They should all be graded according to their scouring or abrasive properties, and not as medicaments. Therefore, I have no choice, but I find it easier to teach proper brushing and to impress the need of stimulating circulation through the use of:

Calcium phosphate precipitated, tribasic
Sodium chlorid
Calcium carbonate, precipitated
Sodium bicarbonate ad 120/0
M. et fac pulverem

Salt leaves a pleasantly clean sensation in the mouth and is a natural tissue stimulant. Sodium bicarbonate is a neutralizer of acid plaques. I impress the patient with the idea of so manipulating the brush as to work the powder between the teeth, where most of the plaques are found. Thus, two important points are gained: the removal of plaques and the increase of circulation in the gum septum.

During the first three years that I practiced preventive dentistry, I obtained approximately 40 per cent cooperation for one year or more. The following three years, I received 51 per cent cooperation, and the last four years, up to March, 1927, I have received approximately 70 per cent cooperation. What has brought about this increased interest on the part of the patient? There are several reasons for it: (1) The public in general is becoming more educated along the lines of oral hygiene. (2) The first three years, I talked fifteen minutes to my patients regarding mouth cleanliness and told them how to brush their mouths, and the remainder of the time I operated, but did no more talking. (3) During the second three years, I talked about thirty minutes at the beginning of the treatment and brushed the patient's mouth from four to six times during the

treatment. For the last four years, I have brushed the patient's mouth at each visit, and have talked all the time, drawing word pictures and demonstrating on models and also on my own mouth with my brush, trying to leave a visual impression on the patient's memory. In other words, I give a postgraduate course to every patient. I might add that I employ the Charters method of brushing.

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NEWSPAPER PUBLICITY AS A MEDIUM FOR LAY EDUCATION*

By P. J. AUFDERHEIDE, D.D.S., Cleveland, Ohio

PUBLICITY in dentistry has been marked by slow but sure progress. From 1700 to 1850, we find all dentists advertising extensively and proclaiming special skill over their fellow practitioners in certain types of work. Beginning with 1840, we see dentistry advancing through the efforts of the thinking men of the profession. A few societies were formed, schools were established and a spirit of cooperation prevailed that led to the establishment of a new code of ethics. Mediums were thereby created whereby knowledge and new discoveries were placed at the disposal of the entire dental profession.

The secrecy of certain methods and operations was eliminated, which gave rise to a standardization of operative procedures, and the old type of competitive advertising became a thing of the past among the men of high ideals. But, at this time, a new type of practitioner developed; namely, the quack. He made sweeping promises to the people through the newspapers, promises that the consciencious man would not make. This has caused much dissatisfaction and misunderstanding between the ethical group of dentists and the laity; first, because the ethical man could not do what he knew to be good dentistry for the advertised prices of the quack, and secondly, wrong and misleading information was given to the public by the quack.

Many intelligent people ask why we do not advertise as do business men. This question must be answered, and to their satisfaction. Advertising would be absolutely wrong because it would result in cheap competition, which would lower the standard of dental service given to the public.

"A competition for cheapness and not for excellency is the ruination of all arts, sciences and professions."

If we do not give our message to the people through organized dentistry, the quack advertisement will be the only education they receive. Remember, only 10 per cent of our population have contact with ethical dentists, and only a small percentage of these dentists have the time or ability to educate all their patients in oral hygiene.

Business houses promote publicity campaigns with a view to educating the people to the worth of their products. Some of this is not of an advertising nature,

*Read before the Section on Mouth Hygiene and Preventive Dentistry at the Sixty-Ninth Annual Session of the American Dental Association, Detroit, Mich., Oct. 26, 1927.

but is presented more as an educational program.

The tendency is to spend money for machinery and its advancement; but the health of mankind, the backbone of the nation, is sadly neglected, and for its advancement little money spent. William Howard Taft, Chief Justice of the Supreme Court, has said, "The care of the individual and family health is the first and most patriotic duty of a citizen."

Disraeli, England's great statesman, said, "Public health is the foundation upon which we repose the happiness and power of a country. The care of public health is the first duty of a statesman."

Too many of our citizens are purchasing luxuries and, with small payments, obligating themselves for months to come. Then, if the care of a physician or dentist is needed, that service must be practically charity, and financed by the community. We are not impressing people with the importance of medical and dental service by giving such service free, particularly to the unworthy. The importance of this service must be conveyed by lay education through all possible channels.

The many foolish and irritating questions and assertions heard by the dentist show that there is much room for a better understanding. For instance:

"Mrs. Jones teeth stay up, and why won't mine?"

"Dr. Smith put brass in my teeth."

"Dr. Brown extracted a tooth for me and my jaw was sore for seven days."

"Dr. White took the nerve out of this tooth, and I can't understand why it aches."

"I don't want the tooth treated, because I can't afford it—I just want it filled."

Many of you probably do not hear remarks of this nature from your clientele, but there are others among you who do, and much can be accomplished to eliminate such misunderstandings by lay education. Enlightening the public as to the honest conditions and possibilities of our service would be highly ethical and constructive.

"Upon the mutual recognition and education and cooperation of both the masses of the laity and the professions lies the solution of the problem of 100 per cent medical and dental service, understanding and cooperation."

There still may be a few men in the dental profession who, through mistaken ethical principles, believe that dental health publicity should not be given to the public. If the laity want us to enlighten them in regard to the possibilities of dentistry, we are doing wrong by cloaking our profession in mystery.

We as dentists have the same avenues open to us that are open to our older sister, the medical profession. By disseminating knowledge on this subject through our dental societies, using as a medium school demonstrations, health days, social service, magazines such as *Hygeia,* lectures, newspaper articles and the radio, we can create a better understanding between the profession and the laity, and a feeling of self-respect and responsibility in the hearts of the dentists.

There is only a small percentage of the population that have the necessary dental work done, or take an interest in having a dental examination every six months and in proper home prophylaxis, or recognize the importance of a proper diet. This is not due to poverty, but to indifference or ignorance.

Frequently, we read in the newspapers some of the wonderful results that have been accomplished by the medical profession, and if we concentrate

our efforts, we will read more about what dentistry has accomplished. It is a peculiarity of the American people that they believe assertions in public print more readily than authoritative statements. Ninety per cent of our people limit their reading and study to the daily paper, and receive their impressions on education through this medium.

Bloodgood[1] says that benign lesions of the mouth have increased in his clinic 50 to 75 per cent, and that up to 1900, only 3 per cent were nonmalignant. He says, "The change since then is due to the education of the public, which began locally in Baltimore in 1902, when the danger of the benign pigmented mole was pointed out, and became national in 1913, when the American society for the Control of Cancer was organized."

The diagnosis, prognosis and treatment in tuberculosis became more promising when the public was given enlightenment on this subject, and today it is not the dreaded disease that it was twenty years ago.

Periodic physical examinations were made possible by educating the people to their importance.

It is a most important duty for us to live up to our teachings and ideals; when we shall see them mirrored in the public.

In considering these facts, a few members of the Cleveland Dental Society conceived the idea that dental health articles published in newspapers would create an educational service to the public and demonstrate, especially to our younger members, that the society was functioning for all members.

After many anticipated difficulties, the president was authorized to appoint a committee of four members who were to prepare articles to be published one at a time every Sunday for a year. Arrangements were made with the *Cleveland Plain Dealer* to publish these articles. On investigation, the committee found that C. B. Fowlkes, New York City, had a series of sixty articles which were published over a period of a year in the *Birmingham News,* by the Southern Society of Periodontology, and could be obtained free of charge. F. Denton White, of Minneapolis, had a series of sixty articles which could be published for one year at a cost of one dollar to each member of our society. Ray Proctor McGee, of Los Angeles, had a series of sixty articles which could be obtained free of charge. These men and several others, namely, Drs. Pettibone, Fones and Eversole, are deserving of our gratitude for the time and energy that they have spent in oral hygiene publicity, which has accomplished so much to advance the profession.

It was decided to re-edit a few of the articles of the Southern Society of Periodontology, and the remainder were written by our local committee and several other members of the Cleveland Dental Society.

It was important that technical terms be eliminated and simple English be used, so that these articles can be understood by the maximum number of readers. Questions were asked for, and a question and answer column created, which published 150 questions and answers on dental subjects. Several letters from out of town and many local telephone calls were received at the society office, all of which demonstrated that the articles aroused considerable interest.

Let it here be said that no names were mentioned in connection with the articles or answers, each individual ar-

1. Bloodgood, J. C.: J. A. M. A., 88:1142 (April 9) 1927.

ticle being headed with "Your Teeth and Your Health; published under the auspices of the Cleveland Dental Society."

The only money expended went to purchase fifty copies of each article from the newspaper, and this amounted to about $40. This enabled us to pass the work on to someone else. At this date, about twenty-five of the entire series have been mailed to different societies requesting them.

The American Dental Association has established a bureau of lay education, which has covered the field in an admirable manner since its establishment. Those to whom credit is due, namely, Miss Evelyn Schmidt and several dentists throughout the country who have assisted her, deserve our gratitude.

In spite of this, only the surface has been touched, and I hope that in the near future enough moral and financial support will be given this bureau to enable it to have available several series of newspaper articles. They should be missionaries encouraging dental societies to carry on lay education.

By nationalizing this activity, we shall reach the people who seldom have contact with the dentist. This idea is not new. Several localities have been active and report excellent results. Dr. Crary, president of the Montana State Dental Society, takes a positive stand in this matter in his article published in the *Editor and Publisher,* and he is only one of a large group that feel the same. He writes:

The only way that we can combat the falsehoods published in newspapers by quacks, and rectify the wrong impressions of the public, is to publish articles with organized dentistry's indorsement, otherwise the evil will persist, and the misunderstanding between laity and public will always exist.

If the dental profession and all its individual members will cooperate so that the public will be so educated as to take an interest in and obtain knowledge regarding dental health and its economic value and absolute necessity for happiness and health, it will benefit both dentist and patient.

If we as dentists take an interest in lay education, we will be able to render more useful service to the public, and, in turn, the public will feel that there can be no accusation of negligence on the part of the dental profession.

636 Rose Bldg.

The Health of the Working Boy*

By Iago Galdston, M.D., New York City

The condition of the teeth of the boys was bad. This may be said of the teeth of most school children and of a most surprisingly large number of adults. In our study, we counted the number of decayed molars in each mouth, feeling, as seems well warranted, that these teeth, more than the others, are concerned with mastication and hence that their condition affects digestion. Without subscribing to the tenets of fletcherism, it is unquestionably well established that the competent mastication of food facilitates digestion. Not only does proper mastication divide the food ingested into fine bits, thus exposing a greater area for the action of the digestive juices, but also mastication stimulates salivary and gastric secretion, both of which are important in digestion. The presence of decayed, broken down and sensitive molars makes mastication difficult and painful, and causes the bolting of food and the avoidance of articles that are hard. This condition throws an excessive burden

*A survey of the health of 2,000 working boys in the East Side Continuation School, New York City. (Dental report from the Bulletin of the New York Tuberculosis and Health Association.)

on the digestive system with various injurious results following.

In addition, decayed teeth which suppurate at the roots and in the gums irritate, tax and sometimes destroy the "filtrating" power of the lymphatic gland of the neck. Some have sought to establish these points as the portals of entry for the tubercle bacillus, tracing the path from the teeth and tonsils through the lymphatics of the neck to the apices of the lungs. While this has not been established, it is undoubtedly true that bad mouth hygiene may in time seriously weaken the lymphatic system of the region and lower that portion of the individual's defense mechanism. Dr. Krause aptly summarizes the question as follows:

"Even though the conditions of tuberculous infection *per se* remained perfectly static, we could expect a tremendous decline in tuberculosis morbidity of children—and, as an indirect consequence, of adults—if all mouths and throats were put in a healthy state and if measles, diphtheria, common colds, etc., were wiped out. In brief, a healthy lymphatic system means a good defense against developing tuberculosis; all burdens laid upon it by non-specific and vicarious irritation lower the threshold to tuberculosis and favor its development in the lymph nodes and its spread from these to more central parts of the body."

The French, who, judging by the quantity of literature produced, have studied the relation of dental hygiene to tuberculosis extensively, share Krause's opinion on the subject. In his thesis on the relation of dental caries to tuberculosis, Dr. Emile Marie Lemoine says: "If, in effect, numerous dental caries in young subjects are not necessarily related to tuberculosis, they do indicate none-the-less a soil poorly defended and ready for all infections."

CURRENT LITERATURE

EXTRACTS AND ABSTRACTS

Vincent's Infection: Pardee, Gordon and Riley (*New England J. Med.*, May 31, 1928) analyze their findings in a study of smears taken from the gums and throats of 462 Smith College students. Numerous fusiform bacilli and spirilla were found in 139 smears. Mild but definite clinical involvement was manifest in 113 cases, but only two developed all the typical symptoms of Vincent's infection. It was the purpose of the authors to seek further information on the general prevalence of the condition, the existence of carriers, the degree of contagion and the influence of poor mouth hygiene and smoking on the condition, as it was felt that data already published were inconsistent and inconclusive in many cases. After the first dozen or more students were found to have the infection, many students come voluntarily for examination, believing themselves to have the symptoms or to have been exposed. Smears obtained by cotton stick applicators were generally sufficient for demonstration of the organisms, but in a few suspected cases with negative reaction, dental technic was necessary to obtain a positive smear. Carbol-fuchsin stain was used, and only smears showing both fusiform bacilli and spirilla were considered positive. Treatment, carried out by local dentists, consisted of daily applications of chromic acid and a mouth wash. Treatment required from two days to two weeks before smears were negative. The fact that good oral hygiene was the rule accounted for the fact that the percentage of positive tests among the whole number examined was lower than percentages obtained by other investigators. In the group studied, moderate smoking (six, eight or more cigarets a day) or occasional smoking seemed to have no particular significance although dentists noted that heavy smoking delayed cure.

Factors in Administration of Ethylene: To the advantages of ethylene over other general anesthetics cited by Chipman, i. e., rapid anesthetization and rapid recovery; reduction of postoperative nausea; absence of cyanosis; relaxation, and absence of sweating, headaches and gas pains, Lewis and Boehm (*Am. J. Surg.*, June, 1928) add the

lack of excitation or stimulation of the nervous system, as shown by normal respiration and circulation, lack of muscular movement and sweating and the simulation of natural sleep. In its chief disadvantage, its explosibility, it differs little from ether. Explosions seem to be largely due to static charges on the apparatus, the anesthetist, the patient or someone standing near. There is little evidence that internal conditions are responsible for the explosions. Many thousands of cylinders are shipped to all parts of the country, and there is no record of any case of spontaneous explosion. There is no evidence that ethylene forms explosive compounds with copper and other metals as does acteylene. The present freedom from impurity would seem to insure against fire or explosion hazard on contact with oxygen. Preventive measures through adequate grounding of any charges that originate in apparatus or the persons involved are described as follows: From the reducing valves connected with the tank, a small insulated copper wire runs along the gas tubes to the metal head of the anesthetic machine. The ends of the wire are soldered in place and the outside of the rubber bags is covered with a metallic paint, which establishes contact with the metal parts in several places. A pint of water is placed in each rubber bag. By means of this water and the moisture all over the inside of the bags, connecting with the metal tube to which the bags are attached, and by means of the moist cloth connected to the metal frame at the back of the apparatus, any potential set up by the gas escaping under high tension through the reducing valves or by friction in the rubber tubes is at once grounded before the mixing of the ethylene and oxygen. The outside of the rubber tube is coated with the metallic paint, thus dissipating any charge due to friction on this tube. Within the tube is a bare spiral copper wire soldered to metal at each end. A connection is soldered to the metallic spiral in the wall of the rubber tube, which prevents the tube from kicking. After the tube has been used some time this metal occasionally becomes exposed to the flow of gases within the tube. Before each operation, water is run through the tube and mask, leaving them wet. The metal of the mask is thoroughly connected to the patient by means of a wet towel or several thicknesses of moist gauze. The anesthetist is connected in the circuit by his hand on the mask and his feet rest on a wet cloth. The table is connected into the circuit by the insulated wire which is soldered to the metal head and by means of a convenient battery clip is easily attached to the table. The table is also grounded through the adjustable metal leg. The authors believe that accidents have often been avoided in the past by the fact that the air of the operating room was humid. This condition of humidity is being purposely provided in many operating rooms by means of a water spray through which the air passes in entering the room.

Cancer and Dental Conditions: According to Lombard and Doering *(New England J. Med.,* April 26, 1928), bad teeth in males were more common among the cancer group than among the controls. This applied to cancer in general and was not limited to cancer of the buccal cavity. Heavy smoking was more common in the cancer group than among the controls. Heavy smoking was largely pipe smoking, and was particularly more common in those persons with cancer of the buccal cavity. The figures gave a suggestion of a hereditary predisposition to cancer. The patients with cancer ate less than the controls, but this probably was wholly due to the presence of the disease.—Abstr. *J. A. M. A.,* June 9, 1928.

Arrest of Dental Caries in Childhood: Boyd and Drain *(J. A. M. A.,* June 9, 1928) base their report on observations made in the course of repeated routine examination of patients in the dental division of a child clinic. Teeth having large cavities, which ordinarily would have an area of softened dentin surrounding the zone of destruction, were found instead to be very dense. In these mouths in which there was evidence of rapid and extensive involvement of many teeth, further invasion was shown by subsequent examinations to be checked and open cavities did not show any signs of progress months after they had first been described. Moreover, the occurrence of salivary calculous deposits on these teeth was almost universal, and it returned rapidly after its thorough removal. Salivary calculus, though not uncommon in the adult, is very unusual in the child. Otherwise, these patients did not show anything noteworthy from a dental standpoint. Some teeth showing unquestionable arrest of caries were found in the most poorly kept mouths. Medical history of patients showing arrested caries revealed that all had been under treatment for diabetes for

six months or more. Caries was active in all cases before treatment was undertaken. In view of the fact that diabetic children are considered as essentially normal when the condition has been controlled by insulin, it is believed that their diet is the essential factor in the arrest of the carious process. The ratio of their protein: carbohydrate: fat intake was 7:9:21. To a large extent, the foods taken were milk, cream, butter, eggs, meat, cod liver oil, bulky vegetables and fruits. Thus a considerable supply of mineral salts and vitamins was assured. The authors believe that it is significant that the ash of the diet was predominantly basic. It would seem that these children have a diet that would be of benefit to the normal child and one that is well above the average dietary. The observations noted would indicate the dependence of dental caries on dietary inadequacies such as might be associated with the usual food intake of the average child.

Practice Building: What are the chief factors that determine a fee in dentistry? To my mind, the things that deserve the highest reward or fee are: 1. Good reputation, earned by honest, faithful service. 2. Good judgment, one's ability to decide what to do and how to do it. 3. Ability to help the patient see the value of the work one proposes doing. 4. Ability to do that which one agrees to do.—J. N. Stewart, in *Oral Health,* May, 1928.

Primary Sarcoma of the Lower Lip: A review of all cases of primary sarcoma of the lip reported in the literature is made by J. V. Falisi (*J. A. M. A.,* June 23, 1928) preceding the report of his own case. In his patient, a robust farmer, aged 35, who did not use alcohol or tobacco and whose history showed no trauma to the lip, a central crack of the lower lip developed, with swelling and discharge of pus. The opening healed, but in spite of large doses of saturated solution of potassium iodid and roentgen-ray therapy, the lesion continued to grow. Examination of a section of the tumor revealed striated muscle fibers being replaced by the neoplasm and numerous mitotic, pyknotic and monster nuclei. The size of the growth decreased under roentgen-ray and radium therapy, but recurrence was evident about two years after the appearance of the original lesion. The general condition was very poor; most of the lower lip had sloughed, and osteomyelitis and necrosis of the mandible were evident. The roentgen ray revealed probable metastasis to the left lung. Death ensued two months later. On section, the primary growth was diagnosed variously as spindle cell sarcoma, malignant leiomyoma and atypical carcinoma, but all who examined the sections from the metastatic nodules in the lungs were agreed on sarcoma.

Oral, Especially Odontogenous, Infection of the Puerperal Uterus: Sachs describes a case of puerperal sepsis traced to infected teeth. (*Zentralbl. f. Gynakol.,* April 7, 1928.) The same bacteria were found in the lochial discharge and in the pus of the decayed teeth, as well as in the nose of the new-born child. These bacteria had remained inactive up to the time of delivery. After extraction of the decayed teeth, the mother made a rapid recovery. There was some question as to whether it was a case of focal infection or one of contact infection. In any event, it shows that infection from the teeth may be transmitted to the pregnant uterus. The author advises that the oral cavity should be examined regularly for pus.—Abstr. *J. A. M. A.*

Dangers of Indiscriminate Removal of Infected Teeth: Probably every physician has seen one or more instances of almost miraculous amelioration of the symptoms of some inflammatory process following the removal of infected teeth. These gratifying results have led, as Dr. Dexter says, to altogether too frequent instances where extraction is ordered without particular study of the individual case and with no thought as to the time or the method of extraction. Thus, in one of the cases cited, an individual, previously in the best of health, died of an overwhelming gangrenous infection of the mouth and face following directly on the removal of two abscessed teeth. In another case, a fatal local and general infection followed the removal of one presumably abscessed tooth. In still another case, a number of presumably infected teeth were removed at one sitting. This was followed immediately by a general blood infection which resulted in death six days after extraction. Other cases were cited wherein the local or general infection following the extraction of infected teeth was extremely grave but not fatal.—*J. Indiana State Medical Association,* March 15, 1928.

AMERICAN DENTAL ASSOCIATION SEVENTIETH ANNUAL SESSION

MINNEAPOLIS, MINN., AUG. 20, 21, 22, 23, 24, 1928

OFFICIAL CALL

To the Members of the American Dental Association:

You are hereby notified that the Seventieth Annual Session of the American Dental Association will be held at Minneapolis, Minn., Aug. 20-24, 1928.

The House of Delegates will convene at 10:00 o'clock in the forenoon and at 2:30 o'clock in the afternoon, Monday, August 20, in the Radisson Hotel. The third meeting of the House of Delegates will be held on Wednesday, August 22, at 2:30 o'clock in the same hotel. The fourth meeting of the House of Delegates will be held on Thursday, August 23, at 2:30 o'clock in the Garrick Theater. The Credentials Committee will register Delegates and Alternates, beginning at 10:00 a. m., Sunday, August 19, at the Radisson Hotel.

All other members must register at the Registration Office in the Minneapolis Auditorium. The Registration Department will be open from 10:00 a. m., until 5:00 p. m., on Sunday, August 19, and from 8:30 a. m., until 5:00 p. m., on Monday, Tuesday, Wednesday, Thursday and Friday, August 20, 21, 22, 23 and 24.

The general meeting, which constitutes the opening exercises of the Session, will be held Tuesday, August 21, at 9:30 a. m., in the Garrick Theater. The second and third general meetings will be held on Tuesday and Wednesday, August 21 and 22, at 8:00 p. m., in the Garrick Theater.

The various sections, general clinics, section clinics, dental health exhibit, scientific exhibit, motion picture program and technical exhibits will be held in the Minneapolis Auditorium, according to their respective programs.

The constituent societies are hereby notified to file with the Secretary of this Association, at least thirty (30) days prior to the first day of said Annual Session, a list of the names and addresses of their Delegates and Alternates.

ROSCOE H. VOLLAND, *President.*
HARRY B. PINNEY, *Secretary.*

MEMBERS OF THE HOUSE OF DELEGATES 1928*

DELEGATES AND ALTERNATES

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Delegates

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J. A. Blue, Empire Bldg., Birmingham
F. F. Perry, Montgomery

ARIZONA

Delegate

Arch G. Fee, 1024 East Seventh St., Tucson

Alternate

R. Dean Creamer, Goodrich Bldg., Phoenix

ARKANSAS

Delegates

Nolan Helstern, Springdale
J. D. Jordan, Boyle Bldg., Little Rock

Alternates

H. L. Leathers, Fayetteville
James T. Peay, Little Rock

ARMY DENTAL CORPS

Delegate

Col. Robert T. Oliver, School of Dentistry, University of Pennsylvania, Philadelphia

Alternate

Major Earl L. Hering, Army Dental School, Army Medical Center, Washington, D. C.

CALIFORNIA STATE

Delegates

Hugh Avary, 209 Post St., San Francisco
J. A. Graham, 209 Post St., San Francisco
John E. Gurley, 350 Post St., San Francisco
Arthur R. McDowell, 344 Fourteenth St., San Francisco
Guy S. Millberry, First and Parnassus Aves., San Francisco
F. T. West, 2569 Mission St., San Francisco

Alternates

Edward J. Howard, 350 Post St., San Francisco
W. H. Robinson, American Bank Bldg., Oakland
Max Wassman, Jr., 323 Geary St., San Francisco
C. E. Post, U. C. Dental College, San Francisco
T. H. Forde, 291 Geary St., San Francisco

CALIFORNIA—SOUTHERN

Delegates

Charles C. Noble, 1741 Crenshaw Blvd., Los Angeles
Bert Boyd, Story Bldg., Los Angeles
J. Franklyn Cook, 511 S. Bonnie Brae Ave., Los Angeles
J. Walter Gray, Medico-Dental Bldg., Los Angeles
E. Ray Brownson, Roosevelt Bldg., Los Angeles
Wallace H. Spinks, Roosevelt Bldg., Los Angeles

Alternates

Carl D. Lucas, Brockman Bldg., Los Angeles
J. Elton Lang, Roosevelt Bldg., Los Angeles
Frank S. Kaiser, Roosevelt Bldg., Los Angeles
Shirley W. Bowles, Merritt Bldg., Los Angeles
Blane J. Goodson, Story Bldg., Los Angeles
Clyde C. Bowe, 624 N. Larchmont Blvd., Los Angeles.

COLORADO

Delegates

E. R. Warner, Metropolitan Bldg., Denver
W. T. Chambers, Metropolitan Bldg., Denver
R. L. Christy, Majestic Bldg., Denver

Alternates

M. R. Howard, Metropolitan Bldg., Denver
E. E. Bailey, Republic Bldg., Denver
W. M. Bennett, State Bldg., Fort Collins

CONNECTICUT

Delegates

J. W. Borchardt, 108 Bank St., Waterbury
C. E. Peterson, 34 Park Place, Rockville
M. J. Loeb, 62 Trumbull St., New Haven
A. E. Cary, 904 Main St., Hartford

Alternates

A. B. Holmes, 43 Central Ave., Waterbury
S. E. Armstrong, 129 Whitney Ave., New Haven
E. R. Bryant, 215 Whitney Ave., New Haven
E. F. Cory, 62 Trumbull St., New Haven

DISTRICT OF COLUMBIA

Delegates

W. M. Simkins, Woodward Bldg., Washington, D. C.
C. Willard Camalier, 1029 Vermont Ave., Washington, D. C.
E. S. Smith, 1101 17th St., N. W., Washington, D. C.

Alternates

Mark F. Finley, 1928 I St., N. W., Washington, D. C.
Bruce L. Taylor, 1801 I St., N. W., Washington, D. C.
G. Albert Smith, 1029 Vermont Ave., Washington, D. C.

FLORIDA

Delegates

C. J. Caraballo, Stovall Bldg., Tampa
C. C. Stewart, Hall Bldg., St. Petersburg

Alternates

Edward L. Thompson, 110½ Orange Ave., Daytona Beach
G. B. Tison, Law Exchange Bldg., Gainesville

GEORGIA

Delegates

DeLos L. Hill, Medical Arts Bldg., Atlanta
J. Russell Mitchell, Candler Bldg., Atlanta
M. D. Huff, Medical Arts Bldg., Atlanta

*This list will be revised, July 20, 1928, in accordance with the ruling as presented in the Constitutional By-Laws, under Chapter IV: Sec. 3—The number of delegates to which each constituent society may be entitled shall be based on the number of members from whom dues for the current year shall have been received by the general secretary of this Association at least thirty days prior to the first day of the annual Session of this Association. . . . Sec. 6—Previous to the annual Session the general secretary of this Association shall prepare and have printed a list of the delegates and alternates, elected by the various constituent societies; also the number of paid members of each.

Alternates
A. A. Lawry, Valdosta
F. C. Wilson, 12 Jones St., E. Savannah
R. R. Byrnes, 106 Forrest Ave., N. E., Atlanta

IDAHO

Delegate
R. N. Packard, Ashton

Alternate
L. D. Blondel, Caldwell

ILLINOIS

Delegates
A. E. Converse, Ridgely-Farmers Bank Bldg., Springfield
H. J. Goslee, 108 N. State St., Chicago
A. B. Patterson, Morris Bldg., Joliet
C. N. Johnson, 58 E. Washington St., Chicago
G. W. Dittmar, 59 E. Madison St., Chicago
D. M. Gallie, 25 E. Washington St., Chicago
W. H. G. Logan, 55 E. Washington St., Chicago
W. F. Whalen, Lehmann Bldg., Peoria
P. G. Puterbaugh, 55 E. Washington St., Chicago
E. D. Coolidge, 25 E. Washington St., Chicago
J. P. Luthringer, Jefferson Bldg., Peoria
F. B. Noyes, 30 N. Michigan Ave., Chicago
C. J. Sowle, Brown Bldg., Rockford
T. L. Grisamore, 29 E. Madison St., Chicago
B. H. Sherrard, Central Trust Bldg., Rock Island
G. M. Hambleton, 29 E. Madison St., Chicago
W. Ira Williams, 122 S. Michigan Ave., Chicago
R. H. Daniels, Lehmann Bldg., Peoria

Alternates
W. D. N. Moore, 220 S. Michigan Ave., Chicago
E. W. King, Geneseo
W. A. McKee, Benton
M. J. Buckley, 30 N. Michigan Ave., Chicago
A. M. Harrison, Stewart Office Bldg., Rockford
E. L. Burroughs, Edwardsville
R. E. Libberton, 7359 Cottage Grove Ave., Chicago
L. B. Torrence, Chester
W. A. Hoover, Gibson City
E. Byron Kelly, 55 E. Washington St., Chicago
F. C. Hopkins, Alton
E. F. Koetters, Illinois State Bank Bldg., Quincy
R. C. Miller, Sandwich
W. B. Downs, Batavia
E. A. Prugh, 104 N. Oak Park Ave., Oak Park
C. R. Baker, 708 Church St., Evanston
J. H. Cadmus, 185 N. Wabash Ave., Chicago
B. S. Partridge, 1305 E. 63rd St., Chicago

INDIANA

Delegates
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C. R. Jackson, Hume Mansur Bldg., Indianapolis
C. E. Redmon, 13 West Third St., Peru
P. N. Chadwick, 130 East Second St., Rushville
W. A. Hall, 107½ East Tenth St., Michigan City
F. R. Henshaw, Medical Arts Bldg., Indianapolis
W. E. Neuenschwander, Medical Arts Bldg., Ft. Wayne

Alternates
W. O. Vallette, 113 South 5th St., Goshen
L. E. VanOsdol, 5 East Third St., Peru
W. R. Meeker, Wallace Theater Bldg., Peru
Victor H. Knapp, Citizens Bank Bldg., Evansville
R. N. Douglas, 506 South Second St., Elkhart
R. R. Gillis, 56 Rimbach Ave., Hammond
Charles A. Priest, Marion Nat. Bank Bldg., Marion

IOWA

Delegates
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H. E. Latcham, Frances Bldg., Sioux City
F. T. Breene, College of Dentistry, Iowa City
C. V. Watts, K. of P. Bldg., Des Moines
L. M. Fitzgerald, Dubuque
Earle S. Smith, 613 East Court St., Iowa City

Alternates
C. E. Westwood, Frances Bldg., Sioux City
H. A. True, Hubbell Bldg., Des Moines
Roy S. Sommers, Equitable Bldg., Des Moines
R. F. Kunz, Mason City
E. A. Schrader, Independence
Charles R. Baker, Central Office Bldg., Davenport

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Homer B. Robinson, Great Bend
Arthur J. Buff, Topeka
Fred A. Richmond, Kansas City

Alternates
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W. T. Triplett, Salina
C. V. Weaver, Clay Center
W. E. Needles, Salina

KENTUCKY

Delegates
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George H. Means, 1380 Bardstown Road, Louisville
W. F. Walz, Fayette Bank Bldg., Lexington
E. C. Hume, Francis Bldg., Louisville

Alternates
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J. H. Foamster, Frankfort
C. W. Meguiar, Franklin
J. H. Gunkle, Newport

LOUISIANA

Delegates
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H. J. Feltus, Roumain Bldg., Baton Rouge
Walter Leabo, Commercial Bank Bldg., Shreveport

Alternates
F. J. Wolfe, Maison Blanche, New Orleans
W. L. Comeaux, La. Nat. Bk. Bldg., Baton Rouge
M. F. Jarrell, Commercial Bank Bldg., Alexandria

MAINE

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Fred S. Woods, Congress St., Portland

MARYLAND

Delegates
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J. Ben Robinson, Medical Arts Bldg., Baltimore
E. W. Swinehart, Medical Arts Bldg., Baltimore

Alternates
O. H. Gaver, Medical Arts Bldg., Baltimore
Harry E. Kelsey, 833 Park Ave., Baltimore
A. G. Twigg, 99 Baltimore Ave., Cumberland

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Delegates
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William Rice, 416 Huntington Ave., Boston
W. Vernon Ryder, 15 Bay State Road, Boston
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C. B. Vaughan, 687 Boylston St., Boston
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Leroy M. S. Miner, 363 Marlboro St., Boston
Harold W. Alden, 160 Main St., Northampton
William H. Gilpatric, 358 Commonwealth Ave., Boston

Alternates
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Edward F. Sullivan, 520 Beacon St., Boston
Frank P. Barnard, 507 Main St., Worcester
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W. Henry Grant, 107 Massachusetts Ave., Boston
John J. FitzGibbon, 58 Suffolk St., Holyoke
Amos I. Hadley, 125 Marlborough St., Boston

MICHIGAN

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Chalmers J. Lyons, Ann Arbor
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Harry F. Parks, Sun Bldg., Jackson
P. C. Lowery, Lowery Bldg., Detroit

Alternates

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Charles T. Ferries, Leopold Bldg., Houghton
M. Webster Prince, 2019 W. Grand Blvd., Detroit
Ward Moore, Grand Rapids Nat. Bk. Bldg., Grand Rapids
A. Alfred Nelson, David Whitney Bldg., Detroit
Eldred G. Robbins, Robbins Block, Ishpeming
Harry L. Hosmer, Stroh Bldg., Detroit

MINNESOTA

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D. R. Miller, Bird Island

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J. F. Brunson, Meridian

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R. P. Abbott, West Point

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Walter Partlett, Wall Bldg., St. Louis
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Virgil R. McCue, Physicians & Surgeons Bldg., St. Joseph
D. D. Campbell, Shukert Bldg., Kansas City
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Earl Westenhaver, Lathrop Bldg., Kansas City
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H. I. Bragg, Columbia

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J. A. Wright, Havre

Alternates

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R. H. Nelson, Missoula

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Alternate

Comdr. Lucian C. Williams, Dental Division, Bureau of Medicine and Surgery, Navy Dept., Washington, D. C.

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H. E. King, Peters Trust Bldg., Omaha
G. A. Grubb, 143 North 13th St., Lincoln
P. T. Barber, City Nat. Bk. Bldg., Omaha

Alternates

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H. C. Brock, North Platte
F. F. Whitcomb, Medical Arts Bldg., Omaha
R. W. Wintersteen, Holdredge

NEVADA

Delegate

Fred H. Phillips, Reno

Alternate

T. C. McConnell, Gardnerville

NEW HAMPSHIRE

Delegate

Guy E. Flagg, Nashua

Alternate

C. B. Laffin, Berlin

NEW JERSEY

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Frederick H. Lum, Jr., 151 Main St., Chatham
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John S. Owens, 109 North Fifth St., Camden
William W. Hodges, 175 Smith St., Perth Amboy
Kenneth C. Pruden, 44 Church St., Paterson

Alternates

Henry J. Gibbins, 221 South Orange Ave., Newark
Eugene W. Roberts, 627 Haddon Ave., Collingswood
Leroy Thomas Asche, 786 Broad St., Newark
Edward C. Stillwell, 71 Winsor Pl., Glen Ridge
Arthur T. Vickers, 509 Cooper St., Camden
Louis F. Kuntz, 180 Smith St., Perth Amboy
Frank T. Maxson, 113 North Ave., W., Cranford

NEW MEXICO

Delegate

C. E. Hagland, Albuquerque

Alternate

J. E. Kraft, Albuquerque

NEW YORK

Delegates

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G. G. Pritchard, 468 Delaware Ave., Buffalo
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J. T. Hanks, 17 Park Ave., New York City
Alfred Walker, 100 W. 59th St., New York City
Theodor Blum, 101 East 79th St., New York City
R. Ottolengui, 80 West 40th St., New York City
F. R. Adams, 8 West 40th St., New York City
E. E. Harrington, Watertown
Harvey J. Burkhart, 800 Main St., Rochester
Edwin F. Mimmack, 266 Bryant Ave., Buffalo
H. P. Massoth, 421 Huguenot Ave., New Rochelle
G. G. Burns, Professional Bldg., Rochester

Alternates

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T. P. Hyatt, 5 East 53rd St., New York City
H. D. Dick, 121 North Pearl St., Albany
L. W. Roohan, 360 Broadway, Saratoga
A. R. Cooke, University Bldg., Syracuse
C. F. Baylis, Oneonta
B. W. Palmer, Gas & Electric Bldg., Rochester
W. Ray Montgomery, Westbrook Apts., Buffalo
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W. A. Squires, 115 Broadway, New York City
A. S. Litten, 230 Central Park West, New York City
R. W. Tench, 116 Central Park South, New York City
J. A. Burgun, 184 Joralemon St., Brooklyn
F. C. Royce, 61 Green Ave., Brooklyn
A. C. Bickelhaupt, City Bank Bldg., Syracuse
E. R. Webb, University Bldg., Syracuse
R. W. Groh, 2561 Main St., Buffalo
C. T. Lansing, 15 North Broadway, Yonkers
George VanDerPool, Hotel Ten Eyck, Albany

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J. H. Wheeler, Greensboro
B. H. Hall, Asheville

Alternates

J. S. Betts, Greensboro
J. S. Spurgeon, Hillsboro
J. Martin Flemming, Raleigh

NORTH DAKOTA

Delegates

Albert Hallenberg, Fargo
F. J. Hartl, Minot

Alternates

H. H. Ewy, Fargo
L. B. McLain, Jamestown

OHIO

Delegates

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J. V. Gentilly, Rose Bldg., Cleveland
G. C. Nixon, Youngstown
F. M. Casto, Keith Bldg., Cleveland
E. C. Mills, 255 E. Broad St., Columbus
T. I. Way, Doctors Bldg., Cincinnati
C. W. Mills, Chillicothe
Harry Cope, 327 E. State St., Columbus
Henry E. Germann, Gwynne Bldg., Cincinnati

Alternates

E. S. Braithwaite, Willard
P. J. Aufderheide, Rose Bldg., Cleveland
H. J. Neidhamer, Gwynne Bldg., Cincinnati
C. S. Smith, Neave Bldg., Cincinnati
G. H. Williamson, Portsmouth
D. P. Snyder, 137 E. State St., Columbus
C. W. Strosnider, 683 E. Broad St., Columbus
T. J. Evans, Home Savings & Loan Bldg., Youngstown
J. J. Welker, Ohio Bldg., Toledo

OKLAHOMA

Delegates

C. R. Lawrence, Enid
A. E. Bonnell, Surety Bldg., Muskogee
E. L. Miley, Medical Arts Bldg., Oklahoma City

Alternates

Charles A. Furrow, Atlas Life Bldg., Tulsa
Ira Malone, Sapulpa
H. D. Warrick, Enid

OREGON

Delegates

H. C. Fixott, Morgan Bldg., Portland
Herbert C. Miller, c/o N. P. D. College, Portland
W. Claude Adams, Selling Bldg., Portland

Alternates

Neal L. Zimmerman, Morgan Bldg., Portland
E. M. Griffin, Stevens Bldg., Portland
C. H. Walrath, Selling Bldg., Portland

PENNSYLVANIA

Delegates

R. E. Black, Huntingdon
W. H. Fordham, Connell Bldg., Scranton
W. L. Fickes, East End Trust Bldg., Pittsburgh
H. E. Friesell, Schenley Apts., Pittsburgh
C. W. Hagan, 1011 Macon Ave., Pittsburgh
E. E. Henry, 1916 E. Dauphin St., Philadelphia
Z. T. Jackaway, 1506 E. Susquehanna Ave., Philadelphia
W. E. Lotz, Tyrone
P. V. McParland, Highland Bldg., Pittsburgh
E. G. Meisel, 121 University Place, Pittsburgh
J. C. Nugent, Central Trust Bldg., Altoona
H. D. Roberts, Johnsonburg
A. I. Wise, Schmidt Bldg., Pittsburgh
A. C. Young, 121 University Place, Pittsburgh

Alternates

C. O. Booth, Vanadium Bldg., Pittsburgh
A. P. Lee, 235 S. 15th St., Philadelphia
W. J. McKinley, 17th & Spruce Sts., Philadelphia
T. A. Hogan, Jenkins Arcade, Pittsburgh
J. V. O'Donovan, Connellsville
Leslie Waddill, Jenkins Arcade, Pittsburgh
J. D. Whiteman, Mercer
J. A. Standen, 1629 Spruce St., Philadelphia
R. E. Denney, Medical Arts Bldg., Philadelphia
G. W. Peiffer, Sewickley
W. A. McCready, Highland Bldg., Pittsburgh
E. H. Moore, 121 University Place, Pittsburgh
H. C. Metz, Highland Bldg., Pittsburgh
F. C. Freisell, Schenley Apts., Pittsburgh

PUBLIC HEALTH SERVICE

Delegate

C. T. Messner, Chief of Dental Service, U.S.P.H.S., Washington, D. C.

Alternate

J. P. Devin, U. S. Marine Hospital, 4141 Clarendon Ave., Chicago, Ill.

RHODE ISLAND

Delegates

B. Cecil Burgess, 56 Snow St., Providence
Ambrose H. Lynch, 511 Westminster St., Providence

Alternates

Albert L. Midgley, Union Trust Bldg., Providence
Ernest A. Charbonnel, 334 Westminster St., Providence

SOUTH CAROLINA

Delegates

J. A. S. Pike, Palmetto Bldg., Columbia
George W. Dick, Sumter

Alternates

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T. C. Sparks, Greer

SOUTH DAKOTA

Delegates

Ernest W. Elmen, Sioux Falls
J. W. Smoots, Spearfish

Alternates

T. E. Burrington, Rapid City
Ward T. Williams, Watertown

TENNESSEE

Delegates
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F. W. Meacham, Hamilton Nat. Bk. Bldg., Chattanooga
J. Baird Jones, Murfreesboro

Alternates
J. W. Winn, Lambuth Bldg., Nashville
D. P. Houston, Hamilton Nat. Bk. Bldg., Chattanooga
Roy O. Elam, Lambuth Bldg., Nashville

TEXAS

Delegates
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A. L. Frew, 4105 Live Oak St., Dallas
R. E. Lee, Edna
Edward L. Williams, Medical Arts Bldg., Houston
W. P. Bolding, Wichita Falls
George H. Mengel, Roberts-Banner Bldg., El Paso

Alternates
Walter T. Newton, Esperson Bldg., Houston
F. F. Brown, Wichita Falls
W. P. Delafield, Medical Arts Bldg., Dallas
W. H. Scherer, Medical Arts Bldg., Houston
T. F. Cox, Scarborough Bldg., Austin
Joseph P. Arnold, Esperson Bldg., Houston

UTAH

Delegates
A. C. Wherry, Deseret Nat. Bk. Bldg., Salt Lake City
E. W. Browning, Boston Bldg., Salt Lake City

VERMONT

Delegate
R. D. Jenney, Bennington

VIRGINIA

Delegates
Harry Bear, Professional Bldg., Richmond
M. B. Rudd, Methodist Publishing Bldg., Richmond
H. Wood Campbell, Suffolk

Alternates
J. E. John, Shenandoah Life Bldg., Roanoke
S. D. Kent, Danville
R. F. Simmons, Medical Arts Bldg., Norfolk

WASHINGTON

Delegates
J. E. Argue, Cobb Bldg., Seattle
George T. Williams, Cobb Bldg., Seattle
J. J. McCarthy, Washington Bldg., Tacoma
Frank G. Burrell, Cobb Bldg., Seattle

Alternates
C. F. Fiset, Cobb Bldg., Seattle
O. C. High, Stimson Bldg., Seattle
James M. Chilson, Medical Dental Bldg., Seattle

WEST VIRGINIA

Delegates
W. E. Minghini, Martinsburg
C. H. Neill, Fairmont
H. E. Summers, Huntington

Alternates
L. A. Stark, Shinnston
C. E. Beal, Anstead
Cullen Amburgy, Williamson

WISCONSIN

Delegates
M. H. Mortonson, Milwaukee
T. A. Hardgrove, Fond du Lac
R. W. Huegel, Madison
J. J. Wright, Milwaukee
J. F. Mortell, Oshkosh
J. C. Mortonson, Milwaukee
G. A. Stratton, Oshkosh

Alternates
E. C. Wetzel, Milwaukee
J. W. Crawford, Milwaukee
D. P. Wheeler, Madison
R. D. Ising, Oshkosh
G. E. Cleophas, Beloit
T. W. Welch, Waupun
M. L. Christensen, Oshkosh

WYOMING

Delegate
C. E. Duncan, Casper

Alternate
Peter Appel, Jr., Cheyenne

MISCELLANY

BOOK REVIEWS

Dental Histology and Embryology. By B. Orban, M.D., Professor of Dental Histology and Pathology, Chicago College of Dental Surgery, Dental Department of Loyola University. 223 pages, with 192 illustrations. Published by Rogers Printing Company, Chicago.

It is seldom that the profession has placed at its disposal as nearly perfect a piece of literature on any subject as is represented by this volume. Dr. Orban is not only a trained scientist but he also has the faculty of imparting his ideas to others in a most acceptable way. For this purpose, he makes a very liberal use of illustrations, and the ones to be found in this book are extraordinarily good. The fine quality of paper used in this volume lends itself to excellence of illustrative presentation, and the author has made the most of it.

In fact, Dr. Orban intimates that the text is reduced primarily to the function of describing the cuts, and there is very little verbiage. For the student who is familiarizing himself with the subject, and for the practitioner who wishes to review his work, the book will be found invaluable. It is a pleasure to recommend it.

Dental State Board Questions and Answers. By R. Max Goepp, M. D., Professor of Principles and Practice of Medicine and of Clinical Medicine at the Woman's Medical College of Pennsylvania. Fourth edition, revised, 463 pages. Price, $4.50. Published by W. B. Saunders Company, Philadelphia and London.

This book was originally issued some years ago, and since the third edition five years have elapsed. This has necessitated adding much new matter and the author has brought the work well up to date.

As a means of reviewing the various subjects just before state board examinations, the book will be found useful, and it will therefore make its particular appeal to those who are preparing for board or other written examinations, and who need some medium for refreshing the memory.

Anatomie fur Zahnarzte. By Harry Sicher and Julius Tandler. 319 illustrations. Published by Julius Springer, Vienna and Berlin.

This anatomy of the teeth and adjacent parts is written in the German language, and will accordingly be of interest chiefly to those familiar with this language. The illustrations, many of which are in colors, are very fine, and will appeal to those interested in the subject whether conversant with the language of the text or not.

NEWS

Newly Elected State Society Officers: The following states report the election of officers for the ensuing year:

Georgia: President, H. H. Williamson, Albany; president elect, W. B. Childs, Macon; vice president, Klatte R. Armstrong, Atlanta.

New Jersey: President, A. E. Boice, Trenton; vice president, Edward L. Wharton, Newark; secretary, Florence K. Heazelton, Trenton; treasurer, George H. Griffith, Trenton.

New Mexico: President, E. G. Brentari, Belen; secretary, Fred Muller, Taos.

New York: President, Gerald Burns, Rochester; president elect, W. C. Fisher, Bronxville; vice president, Alfred Walker, New York City; secretary, A. P. Burkhart, Auburn; treasurer, G. H. Butler, Syracuse.

Oklahoma: President, W. J. Scruton, Oklahoma City; president elect, Roy H. Ellis, Okmulgee; secretary, E. E. Sanger, Yukon; treasurer, C. A. D. Beer, Enid.

Oregon: President, A. J. Brock, Portland; vice president, R. J. Gunn, Corvallis; secretary, F. W. Hollister, Portland; treasurer, P. T. Meaney, Portland.

Southern California: President, Charles C. Noble, Los Angeles; vice president, H. C. Peisch, Pasadena; president elect, Charles O. McBean, Los Angeles; secretary, Charles M. Alderson, Los Angeles; treasurer, Frank G. Staley, Los Angeles.

Texas: President elect, George H. Mengel, El Paso; vice president, Tom F. Coyle, Orange; secretary-treasurer (reelected), J. G. Fife, Dallas.

Virginia: President, R. C. Walden, Richmond; secretary-treasurer, A. M. Wash, Richmond; president elect, J. E. John, Roanoke.

Dental Officers to Summer Camps: Following is a list of dental reserve officers who have been ordered to summer military training camps within the Seventh Corps Area:

Ray Victor Smith, Captain, Iowa City, Iowa.

James Novack Crawford, First Lieutenant, Bovey, Minn.

Charles Rederer, Captain, St. Louis, Mo.

William John Willmering, First Lieutenant, St. Louis, Mo.

Leonard Conrad Brusletten, Major, Faribault, Minn.

Lloyd Marion Barger, First Lieutenant, Kansas City, Mo.

John Marvin Beard, First Lieutenant, St. Louis, Mo.

Curtis Shackelford McKinney, First Lieutenant, Excelsior Springs, Mo.

Claude Wilson O'Dell, First Lieutenant, Kansas City, Mo.

Raphael Egglestone Burke, Captain, Marshalltown, Iowa.

Harry Robert Cochran, Captain, Sheldon, Iowa.

William Harry Fields, Captain, Clarksville, Iowa.

John Gilbert Colgan, First Lieutenant, McCook, Nebr.

Irving Edward Larson, First Lieutenant, Adams, Nebr.

Henry William Ralstin, First Lieutenant, Wichita, Kan.

Loy Harold Van Fossan, First Lieutenant, Wichita, Kan.

Thomas Harold Tye, Major, Cameron, Mo.

Charles William Steward, First Lieutenant, Fontanelle, Iowa.

Rufus Bryan Galbraith, First Lieutenant, What Cheer, Iowa.

Clarence Charles Pitlik, First Lieutenant, Mt. Vernon, Iowa.

Chase Rowland Weeber, First Lieutenant, Iowa City, Iowa.

George Shadford Easton, First Lieutenant, Iowa City, Iowa.

Clarence Hess Van Deventer, Major, Kansas City, Kan.

Carl Joshua Benning, First Lieutenant, Springfield, Mo.

Walter Louis Hull, First Lieutenant, Edgar, Nebr.

Earl Allen Nelson, First Lieutenant, Minneapolis, Minn.

Frank Oviatt Raney, First Lieutenant, Springfield, Mo.

Glenn Everett Staley, First Lieutenant, Omaha, Nebr.

Drs. Friesell and Midgley on Governor's Staff: H. E. Friesell, of Pittsburgh, Pa., and Albert L. Midgley, of Providence, R. I., have been commissioned as colonels by Lieutenant Gov. James Breathitt, Jr., of Kentucky, to serve on his staff.

Distribution of Dentists in France: According to the *Revue de chirurgie dentaire*, France had in 1926 one dentist for each 6,650 inhabitants. In the provinces (outside Paris), there is one dentist for each 9,300 inhabitants. In the Lozere region, there are only three dentists for a total population of 108,824. Many other sections of France have but one dentist for each 20,000 inhabitants.—Paris letter, *J. A. M. A.*, May 12, 1928.

DEATHS

Conn, Charles William, Uniontown, Pa.; University of Pittsburgh School of Dentistry, 1918; died, May 20.

Gibbs, B. F., Council Bluffs, Iowa; Creighton University College of Dentistry, 1911; died, June 19, from injuries suffered when an airplane in which he was enroute to Denver crashed and fell into the Platte River.

Hammond, Grace T., Beacon Hill, N. Y.; Pennsylvania College of Dental Surgery, 1921; died recently. Dr. Hammond formerly resided in Washington, D. C.

Katz, Hannah, Chicago, Ill.; University of Illinois, College of Dentistry, 1926; died, June 17.

Morgan, R. O., Tyler, Texas; died, June 21, aged 61. Dr. Morgan suffered a paralytic stroke three days before his death.

Wanko, E. H., Milwaukee, Wis.; Temple University School of Dentistry, 1881; died, June 10.

Woodward, Marion L., Boston, Mass.; Boston Dental College, 1891; died recently.

ANNOUNCEMENTS

CALENDAR OF MEETINGS*

NATIONAL SOCIETIES

American Dental Association, August 20-24, 1928, Minneapolis, Minn.

American Academy of Periodontology, August 16-18, 1928, Minneapolis, Minn.

American Academy of Restorative Dentistry, August 17-18, 1928, Minneapolis, Minn.

American Dental Assistants Association, August 21-23, 1928, Minneapolis, Minn.

American Dental Hygienists Association, August 20-23, 1928, Minneapolis, Minn.

American Society of Oral Surgeons and Exodontists, August 17-18, 1928, Minneapolis, Minn.

Association of Military Dental Surgeons, August 20-24, Minneapolis, Minn.

Federation of American Women Dentists, August 20, 1928, Minneapolis, Minn.

National Association of Dental Examiners, August 18, 1928, Minneapolis, Minn.

STATE SOCIETIES

District of Columbia, at George Washington University, Washington, D. C., second and fourth Tuesdays in each month from October to June inclusive.

September (1928)

Maryland, at Annapolis (10-11).

December (1928)

Ohio, at Toledo (4-6).

May (1929)

West Virginia, at White Sulphur Springs (20-22).

Chicago Dental Society Midwinter Clinic, Jan. 14-16, 1929.

First District Dental Society of the State of New York, Dec. 3-6, 1928.

*Announcements must be received by the fifth day of the month in order to be published in the forthcoming issue of THE JOURNAL.

ASSOCIATION OF MILITARY DENTAL SURGEONS

The next annual meeting of the Association of Military Dental Surgeons of the United States will be held at Minneapolis, in connection with the annual meeting of the American Dental Association, August 20-24. Headquarters of the association will be established at the Leamington Hotel and the annual banquet will be held at that hotel on Tuesday evening, August 21, commencing at 6:30 o'clock. Tickets for the banquet can be obtained at association headquarters or from F. A. Boylan, 612 Besse Building, Minneapolis, chairman of the Arrangements Committee. All Dental Corps Reserve officers are invited to participate with us in this banquet.

AVERY G. HOLMES, *Sec'y-Treas.*
Captain, Dental Corps, U. S. Army

PAST PRESIDENTS LUNCHEON

The luncheon for the Past Presidents of the American Dental Association will be held August 21, at 12:30 p. m., at the Radisson Hotel, Minneapolis.

MOUTH HYGIENE LUNCHEON

The annual Mouth Hygiene Luncheon of the American Dental Association will be held at the Curtis Hotel, Wednesday, August 22. Tickets, $1.50.

MINNESOTA STATE DENTAL ASSOCIATION LUNCHEON

A luncheon will be given the Delegates and Officers of the American Dental Association by the Minnesota State Dental Association, August 20, at 12 m., at the Radisson Hotel, Minneapolis.

SCIENTIFIC FOUNDATION AND RESEARCH COMMISSION, A. D. A.

The Scientific Foundation and Research Commission of the American Dental Association will meet at 2:00 p. m., Sunday,

August 19, at the Radisson Hotel, Minneapolis.

TRANSPORTATION

An Identification Certificate will be sent to each member of the American Dental Association, approximately one month in advance of the meeting. When properly filled out and presented to the local railway agent, it will authorize him to sell a round trip ticket to the member for himself and dependent members of his family, at one and one-half fares. Selling dates for these tickets will be August 15, 16, 17, 18, 20 and 21, with return limit, August 30.

JOHN R. BARTIZAL, *Acting Chairman,*
Transportation Committee

ATTENTION—GOLFERS

The annual tournament of the American Dental Golf Association will be held in Minneapolis, August 19-20, beginning with the golf banquet and Calcutta Pool, August 19, at 6:30 p. m. Monday, August 20. The big tournament will be held at the Golden Valley Club. The championship game will be played off at the Interlachen Country Club. Life membership in the Golf Association is $3. Apply to

E. W. BROWNING,
921 Boston Bldg.,
Salt Lake City, Utah

TRAPSHOOTERS

The Trapshooters of the American Dental Association will hold their annual shoot, Tuesday, August 21, at 2:00 p. m., at the Twin City Shooting Association Grounds, Minneapolis. Those wishing to participate should register on arrival in Minneapolis. All standard makes of shells will be sold on the grounds. Cups and various prizes have been arranged for. The program will include a 100 target event, 16 yard rise.

A. C. ENGEL, *Secretary,*
930-934 Arcade Bldg.,
St. Louis, Mo.

MEETING OF STATE SOCIETY AND A. D. T. A. REPRESENTATIVES

Representatives of the state dental societies and of the American Dental Trade Association will meet at 4:00 p. m., Sunday, August 19, at the Radisson Hotel, Minneapolis.

FEDERATION OF AMERICAN WOMEN DENTISTS

The seventh annual meeting of the Federation of American Women Dentists will be held at the Plaza Hotel, Minneapolis, Monday, August 20. Registration will begin at 10:00 a. m. A business session will be held in the afternoon, beginning at 2 o'clock. At 5 p. m., transportation will be available for a short drive over the boulevards, ending at one of the country clubs, where a banquet will be served. Reservations may be made with Dorothea F. Radusch, 909 Metropolitan Bldg., Minneapolis.

MARY B. MEADE, *President,*
Carmi, Ill.
WILHELMINA YERETSKY, *Secretary,*
26 Sheldon Ave., S. E.,
Grand Rapids, Mich.

AMERICAN ACADEMY OF RESTORATIVE DENTISTRY

The American Academy of Restorative Dentistry will meet at the Minneapolis Club, 729 Second Avenue South, Minneapolis, August 17-18.

RALPH L. MORRISON, *Sec'y-Treas.,*
The Rochambeau,
Washington, D. C.

AMERICAN SOCIETY OF ORAL SURGEONS AND EXODONTISTS

The tenth annual meeting of the American Society of Oral Surgeons and Exodontists will be held at the Radisson Hotel, Minneapolis, August 17-18.

HARRY BEAR, *Secretary,*
410 Professional Bldg.,
Richmond, Va.

AMERICAN ACADEMY OF PERIODONTOLOGY

The fifteenth annual meeting of the American Academy of Periodontology will be held at the Nicollet Hotel, Minneapolis, August 16-18. The annual banquet will be given Saturday evening, August 20.

JUSTIN D. TOWNER, *President,*
Exchange Bldg.,
Memphis, Tenn.
J. HERBERT HOOD, *Secretary,*
Hanna Bldg.,
Cleveland, Ohio

NATIONAL ASSOCIATION OF DENTAL EXAMINERS

The next meeting of the National Association of Dental Examiners will be held in Minneapolis, August 18.

GEORGE L. POWERS, *Secretary,*
Bank of Commerce Bldg.,
Memphis, Tenn.

AMERICAN DENTAL HYGIENISTS' ASSOCIATION

The American Dental Hygienists' Association will meet at the Curtis Hotel, Minneapolis, August 20-23.

AGNES G. MORRIS, *Secretary,*
886 Main St.,
Bridgeport, Conn.

AMERICAN DENTAL ASSISTANTS ASSOCIATION

The American Dental Assistants Association will meet August 21-23, at the Leamington Hotel, Minneapolis.

RUTH F. ROGERS, *General Secretary,*
Rm. 803, 223 W. Jackson Blvd.,
Chicago, Ill.

UPSILON ALPHA SORORITY

The Upsilon Alpha Sorority will meet at a dinner, Wednesday, August 22. Make reservations with Dagny I. Just, 907 Yeates Bldg., Minneapolis.

DOROTHEA F. RADUSCH, *President,*
909 Metropolitan Bank Bldg.,
Minneapolis

XI PSI PHI

The Xi Psi Phi Fraternity will have headquarters at the Dyckman Hotel, Minneapolis, Room 211, during the Annual Session of the American Dental Association. Headquarters for the ladies will be Room 206. The annual banquet will be held August 20, at 6:30 p. m., at the Leamington Hotel. All members and their wives are welcome.

WILLIAM MCDOUGALL, *Chairman,*
Arrangements Committee,
426 Syndicate Bldg.,
Minneapolis, Minn.

PSI OMEGA FRATERNITY

The headquarters for the Psi Omega Fraternity will be the West Hotel, Minneapolis. Following is the program:

August 19—

Meeting of the Supreme Council, National Alumni Chapter, Officers and Local Committee, at 4 p. m.

August 20—

Registration and business meeting of the National Alumni Chapter, at 2 p. m.

Banquet, 6:30 p. m., at Minnekahda Club. Early reservations are advised.

H. E. FRIESELL, *Supreme Grand Master,*
Schenley Apts.,
Pittsburgh, Pa.

DELTA SIGMA DELTA FRATERNITY

The forty-fourth annual meeting of the Supreme Chapter of Delta Sigma Delta Fraternity will be held in the Nicollet Hotel, Minneapolis, Minn., August 20. The Minneapolis Auxiliary Chapter extends to all our members an invitation to be present, with the assurance that all will receive a hearty welcome. The convention will be held in the Land of Ten Thousand Lakes, so do not forget fishing and camping equipment. The first session will be held at 9:30 a. m., and a second session immediately after lunch. Initiatory exercises will be held during the afternoon session. The banquet will be held at 6:30 p. m., at the Nicollet Hotel. Those expecting to attend should notify Brother Ralph Ackley, 1501 Glenwood Ave., Minneapolis, chairman of the Committee on Hotels and Reservations. For general information, consult Brother George Damon, La Salle Bldg., Minneapolis.

By order of the Supreme Chapter,

FRANK MONROE CASTO,
Supreme Grand Master,
Keith Bldg.,
Cleveland, Ohio

R. HAMILL D. SWING,
Supreme Scribe,
Elrae Bldg.,
Philadelphia, Pa.

ALPHA OMEGA FRATERNITY

A meeting of the Supreme Council will be held at the Nicollet Hotel, Minneapolis, Monday, August 20. The first session will be held at 9:30 a. m. An afternoon session will be held immediately after lunch. Matters of importance will come up for action during the morning and afternoon sessions. It is hoped that all fraters will attend. The banquet will be held at 6:00 p. m. at the

Nicollet Hotel. To avoid delay in registration, kindly present your membership card. The local chairman is Irwin Epstein, 403 Pittsburgh Bldg., St. Paul, Minn.

By order of the Supreme Chancellor, A. H. Mendelsohn, Medical Arts Bldg., Baltimore, Md.

A. M. FLASCHNER, *Supreme Scribe,*
419 Boylston St.,
Boston, Mass.

NORTHERN ILLINOIS DENTAL SOCIETY

The Northern Illinois Dental Society will hold its forty-first annual meeting at Joliet, October 10-11.

P. B. UNDERWOOD, *Secretary,*
Elgin.

FIRST DISTRICT DENTAL SOCIETY STATE OF NEW YORK

The Fourth Annual December Meeting for Better Dentistry of the First District Dental Society of the State of New York will be held at the Hotel Pennsylvania, New York City, Dec. 3, 4, 5, 6, 1928. As will be noticed, there will be an extra day of clinics and lectures this year. The list of essayists and clinicians is about ready and will be announced at an early date. The same plan of subscription will be continued this year; viz., $5.00 admits a member to all lectures, clinics, etc. A subscription blank and list of clinics will be ready for circularization November 1.

There will be a manufacturers' exhibit in the hotel during the meeting.

CHICAGO DENTAL SOCIETY SIXTY-FIFTH ANNUAL MEETING AND CLINIC

January 14-16, 1929

Stevens Hotel

The Chicago Dental Society wishes to announce the 1929 Annual Meeting and Clinic at the Stevens Hotel. Please take notice of change from the Drake Hotel to the Stevens Hotel with its 3,000 rooms ranging from $4.00 upwards, with ideal conditions for staging the yearly classic.

All members of the American Dental Association are cordially invited to attend. Preliminary programs will be mailed to all members of the A. D. A. sometime in December of this year. The program will be divided into eight sections as follows:

Section I—OPERATIVE DENTISTRY
Chairman: O. J. Olafsson, 55 E. Washington St.
Secretary: E. J. Krejci, 7060 Clyde Ave.

Section II—FULL DENTURES
Chairman: R. O. Schlosser, Northwestern University.
Secretary: E. C. Pendleton, Chicago College of Dental Surgery.

Section III—PARTIAL DENTURES; CROWN AND BRIDGE
Chairman: Stanley D. Tylman, 185 N. Wabash Ave.
Secretary: W. H. Kubacki, 2949 Milwaukee Ave.

Section IV—MOUTH HYGIENE, CHILDREN'S DENTISTRY
Chairman: E. E. Graham, 58 E. Washington St.
Secretary: E. W. Swanson, 25 E. Washington St.

Section V—ORTHODONTIA
Chairman: B. O. Sippy, 30 N. Michigan Ave.
Secretary: C. R. Baker, 708 Church St., Evanston.

Section VI—ORAL PATHOLOGY
Chairman: E. H. Hatton, Northwestern University.
Secretary: J. R. Blayney, University of Illinois.

Section VII—ORAL SURGERY
Chairman: J. E. Schaefer, 55 E. Washington St.
Secretary: Eli Olech, 4259 W. Madison St.

Section VIII—RADIOLOGY
Chairman: E. H. Thomas, 30 N. Michigan Ave.
Secretary: M. A. Root, Jr, 636 Church St., Evanston.

The Program Committee is under the direction of Frederick B. Noyes, assisted by Stanley D. Tylman, vice-chairman, I. G. Jirka, Charles R. Baker and Howard Alexander.

LOUIS E. JELINEK, *President*
HUGO G. FISHER, *Secretary*
185 N. Wabash Ave.

HOTELS	Rooms	WITH BATH		WITHOUT BATH	
		One Person	Two Persons	One Person	Two Persons
RADISSON 7th St. between Hennepin & Nicollet	500	$3.00-6.50	$5.00-30.00	$2.00-2.75	$4.00
NICOLLET Washington at Nicollet	600	2.50-6.00	4.00-8.00	2.00	3.50
CURTIS 10th St. & 4th Ave. S.	825	2.00-3.00	3.00-6.00		
LEAMINGTON 3rd Ave. S. at 10th St.	500	2.50-4.50	3.50-6.00		
SHERIDAN 1112 Marquette	450	2.50 up	3.50 up	1.50 up	2.50 up
ANDREWS Hennepin & 8th St.	328	2.50-6.00	4.00-7.00	2.00-2.50	3.00-3.50
BUCKINGHAM LaSalle & 15th St.	138	2.50-3.50	4.00-6.00		
CAMFIELD Marquette & 8th St.	100	1.50-1.75	2.50	1.25	2.00
DYCKMAN 6th St. between Hennepin & Nicollet	300	2.00-5.00	4.00-7.00		
FRANCIS DRAKE 10th St. & 5th Ave. S.	160	2.50-5.00	3.50-6.00		
ELGIN Hennepin & 8th St.	125	1.50	3.00 up	1.00	2.00 up
HASTINGS 12th St. & Hawthorne	150	1.75-4.00	2.50-5.00		
MARYLAND LaSalle & Grant	172	2.00-2.50	3.00-3.50		
PLAZA Kenwood Parkway & Hennepin	160	2.50-6.00	3.50-6.00		
PAULY Nicollet & High	48			1.00-1.50	1.50-2.00
ROGERS Nicollet & 4th St.	200	2.00-2.50	3.50-5.00	1.25-1.50	2.50
RUSSELL 16 S. 4th St.	125	1.50-2.50	2.50-4.00	1.25-1.50	2.00-3.00
SENATOR 314 S. 8th St.	80	2.00 up	3.00 up		
ST. REGIS Marquette & 9th St.	58	1.50-3.00	2.50-4.00		
VENDOME 4th St. between Hennepin & Nicollet	250	1.75	3.00-3.50	1.25-1.50	2.00-2.50
WEST Hennepin & 5th St.	362	2.00-4.00	3.00-5.00	1.50-2.00	2.50-3.00

AMERICAN DENTAL ASSOCIATION

Minneapolis, Minnesota. August 20 to 24, 1928.

HOTEL RESERVATION

The Housing Committee for the American Dental Association meeting in Minneapolis has compiled a roster of hotels approved by the Minneapolis Civic and Commerce Association and the Hotel Association.

Please be accurate in filling out the reservation form below and send it to the hotel of your first choice. You will be advised by the hotel of the receipt and listing of your reservation.

In the event that the reservation of your first choice cannot be made, the hotel manager will forward this blank to the Chairman of the Halls and Hotels Committee. He will place your reservation under either your second or third choice; or, if these are not available, in as favorable a hotel as possible. You will be advised of the name and location of the hotel in which the reservation is made and the hour at which the reservation begins. Rooms not occupied at the designated hour of the reservation may be reassigned by the hotel.

Please remember that a reservation constitutes a contract with the hotel to provide you with the accommodations that you desire. If you find it impossible to carry out your part of the contract, namely, to occupy the room at the time agreed on, please write or wire the hotel releasing it, in order that your room may be made available for other members.

MAIL THIS APPLICATION DIRECT TO HOTEL

HOTEL RESERVATION

AMERICAN DENTAL ASSOCIATION, MINNEAPOLIS, MINN., AUG. 20 TO 24, 1928

.....Hotel.

Minneapolis, Minn.

Dear Sir: Please make reservations noted below:

.....rooms with bath for.....persons. Rate: $.....to $.....per day per room

.....rooms without bath for.....persons. Rate: $.....to $.....per day per room

Date of arrival.....Hour.....

Date of leaving.....

Please note the following second and third choice of hotels:

Second choice.....

Third choice.....

Room or rooms will be occupied by

NAME	ADDRESS IN FULL
.....	.....
.....	.....

Name of applicant.....

Street and number.....City and State.....

Please confirm this reservation to applicant. I further agree to notify the hotel immediately in event I am unable to use this reservation.

Important to hotel manager:—In event that you cannot accept this reservation, please forward this application at once to Dr. W. C. Naegeli, Chairman Halls and Hotels Committee, American Dental Association, 301 Donaldson Bldg., Minneapolis, Minn., who will attend to the assignment of this reservation.

LIBRARY BUREAU EXHIBIT AT MINNEAPOLIS

At the Minneapolis meeting, the Library Bureau of the American Dental Association will show material illustrative of the three types of service now being given.

CIRCULATION OF BOOKS

Late 1927 and early 1928 books on or pertaining to dentistry will be exhibited. These may be borrowed from the Library Bureau after the meeting. There is no charge for loaning books, but a two dollar deposit is requested for each book borrowed. For the benefit of those unable to attend the meeting, a list of these books will be printed in the announcements of the October issue of THE JOURNAL.

PACKAGE LIBRARIES

Twenty-five package libraries on the subjects most frequently asked for will be shown. A package usually contains eighteen or twenty clippings or reprints on a subject and is really a miniature library. The packages are loaned, but there is a charge of fifty cents for this privilege.

BIBLIOGRAPHIES

A bibliography on Vincent's infection including a majority of the magazine articles published between January, 1924, and July, 1928, will be given away. Those not attending the meeting will be given copies, on request, as long as the supply lasts.

Suggestions will be welcomed from those who have used the service, and the librarian hopes to have an opportunity to acquaint new members with the material available.

(MRS.) JOSEPHINE P. HUNT, *Librarian.*